האגודה הישראלית למיקרוסקופיה
THE ISRAEL SOCIETY FOR MICROSCOPY

TECHNION
Israel Institute
of Technology

"GOLD AGE" by Chalom Zmmour, HUJI
ISM2025 Best Micrograph

ISM 2026

The 59th Annual Meeting of the
Israel Society for Microscopy

May 14, 2026
Expo Tel Aviv, Pavilion 2, Tel-Aviv

PROGRAM & ABSTRACTS

TABLE OF CONTENTS

Cover page micrograph:

"GOLD AGE"

Winning micrograph of the ISM2025 Micrographs Competition by Chalom Zemmour, HUJI

WELCOME LETTER

Dear Colleagues,

We are very happy and excited to welcome you to the 59th Annual Meeting of the Israel Society of Microscopy (ISM). Over the past three years, our scientific community has continued to demonstrate resilience, dedication, and the ability to move forward even under challenging circumstances. We remain committed to fostering scientific exchange, collaboration, and innovation, and we trust that this meeting will provide a productive and inspiring environment for all participants.

We are grateful to all members of our community who continue to contribute to science, education, and research, and we hope that this meeting will strengthen both existing collaborations and new scientific connections.

A pre-meeting tutorial workshop on Analytical Electron Microscopy will be held on May 13th at the Department of Materials Science and Engineering, Technion – Israel Institute of Technology. The workshop, organized by Yaron Kaufmann and Olga Kleinerman, will include lectures and demonstrations on analytical data acquisition and analysis using TEM, SEM, and Atom Probe.

The main meeting will take place on May 14th in Tel Aviv, featuring talks that present cutting-edge research and reflect the remarkable advances achieved in recent years across many fields of microscopy, in materials science, life sciences, and instrumentation and method development. We thank our scientific committees led by Leeya Engel, Adi Salomon, and Ido Kaminer for selecting the invited speakers, contributed talks, and posters. We warmly welcome our distinguished plenary speakers, Benny Geiger and Boaz Pokroy.

The meeting is generously supported by 20 companies and academic institutes, and we encourage you to visit their booths and explore the latest technological innovations they present.

We also invite you to participate in the Poster Soundbites Session, which offers a platform for short presentations by graduate students, and later, visit the posters and engage in discussions. Please remember to vote for the best micrograph.

This year, for the first time, we will present the ISM Travel Award to MSC 2026, granting up to 5,000 NIS to support one young scientist presenting their work at the 52nd Annual Microscopy Society of Canada 2026. Congratulations to Yael Noy from the Weizmann Institute for receiving the ISM Travel Award to MSC 2026. In addition, two Eyal Shimoni Travel Scholarships, granting up to 5,000 NIS each, will be given to two graduate students to support their travel to a conference or workshop. Congratulations to Feiyan Zhao from Tel-Aviv University and Wajdi Nicola from the Technion for receiving the Eyal Shimoni Travel Scholarship. We thank Mr. Eran Tadmor, a close friend of Dr. Shimoni, for his generous support.

The ISM also awards two Excellence Prizes- Yael Mutsafi Memorial Prize and Lev Margulis Memorial Prize, which are given to two young scientists for their excellent scientific work. Congratulations to the Mutsafi Memorial Prize recipient, Shani Nadav-Eliayahu from Bar-Ilan University, and to the Margulis Memorial Prize recipient, Daniel Khaykelson from the Weizmann Institute. Both recipients will present their work during the afternoon parallel sessions. We thank the Mutsafi family for their generous support.

We hope that you will enjoy this meeting, find it fruitful, and be inspired by the talks, posters, and discussions with colleagues and experts from across the country.

Best wishes on behalf of the ISM Board and the ISM2026 Organizing Committee,

Tamar Segal-Peretz	Gabriel Frank	Alexander Upcher
Chair, ISM	Secretary, ISM	Treasurer, ISM

GENERAL INFORMATION

Meeting Venue

Pavilion 2, Expo Tel Aviv
101 Rokach Blvd
Tel Aviv
Tel: +972-3-640-4444

Transportation

Train - to Tel Aviv University Train Station. Train schedule: Click here

Registration & Hospitality Desk

Registration and distribution of the meeting materials will take place throughout the event, from 08:00 until the end of the last session.
Upon arrival at the meeting venue, please scan the QR code below at the registration desk. This will help streamline the check-in process.

Scientific Program

Important note: This year, the full meeting booklet - including the program, abstracts, and more - will be published in digital form.

- **To view the Meeting Program with link to abstracts, please click here**
- **To view the Posters program with link to abstracts, please click here**
- **Technical Information for speakers, please click here**
- **Technical Information for poster presenters click here**

Speakers and Session Chairs

To ensure the smooth running of the sessions, speakers and session chairs are required to meet 10 minutes before their session begins, in their designated session hall, to coordinate all necessary details.

Please make sure to save your presentation and bring it on a USB memory stick, and name the file with your name and session name (e.g. “John_Doe_Tue_SessXX.pptx”).

Weapons

Please note that no weapons of any kind are allowed in Expo Tel Aviv, and there is no option to deposit weapons on-site.

Internet

Free Wi-Fi will be available at all meeting areas.

Parking

EXPO guests may use the roofed parking spaces, which are easily accessible for everyone, including people with disabilities.
Select on Waze Expo Tel Aviv Gate #7.
Rate: NIS 56 per day.

Balance of Payment

Please note that any outstanding balance for registration, as reserved on the Meeting Registration Form, must be paid to Diesenhaus-Unitours at the Hospitality Desk.

We wish you a successful and enjoyable Meeting.

Conference Secretariat

Diesenhaus-Unitours Incoming Tourism Ltd.
Conventions Department
Tel: +972(0)73-3945279
E-mail: oritg@diesenhaus.com

ORGANIZING COMMITTEES

General Organizing Committee

Tamar Segal-Peretz, Chairperson, Technion
Gabriel Frank, Secretary, Ben-Gurion University
Alexander Upcher, Treasurer, Ben-Gurion University
George Levi, Tel-Aviv University
Yaron Kauffmann, Technion
Yuval Garini, Technion
Yaron Shav-Tal, Bar Ilan University
Yevgeny Rakita, Ben-Gurion University
Ifat Kaplan-Ashiri, Weizmann Institute of Science
Lothar Houben, Weizmann Institute of Science
Tom Schultheiss, Technion
Doron Naveh, Bar Ilan University
Natalie Elia, Ben-Gurion University
Einat Zelinger, Hebrew University
Gili Bisker, Tel-Aviv University

Life Sciences Scientific Committee

Leeya Engel, Chair, Technion
Gabriel Frank, Ben-Gurion University
Yoav Shechtman, Technion

Materials Science Scientific Committee

Adi Salomon, Chair, Bar-Ilan University
Amnon Rothman, Ben-Gurion University
Assaf Gal, Weizmann Institute of Science

Frontiers in Instrumentation and Methods committee:

Ido Kaminer, Technion
Ady Arie, Tel-Aviv University

SPONSORS & EXHIBITORS

The Israel Society for Microscopy gratefully acknowledges the support and assistance rendered by the following:

Platinum Sponsors

Silver Sponsors

Research and Academic Institutes

Pre-Meeting Workshop Program - May 13th

09:30 – 09:50	**Get together & Coffee**			
09:50 - 10:00	***Welcome and Introduction - Prof. Eugen Rabkin**, Dean of the Department of Materials Science & Engineering*			
	Morning Session			
Session Chair:	**Tamar Segal-Peretz**, Technion			
10:00 - 10:35	**Wayne D. Kaplan** / Technion ***ANALYTICAL ELECTRON MICROSCOPY FOR MATERIALS SCIENCE: GOING BEYOND COMPOSITION ALONE***			
10:35 - 11:10	**Alex Berner** / Technion ***STATISTICAL ASPECTS IN ANALYTICAL ELECTRON MICROSCOPY***			
11:10 - 11:25	**Coffee break**			
Session Chair:	**Alexander Upcher**, Ben-Gurion University			
11:25 - 12:00	**Lothar Houben** / Weizmann Institute ***EELS IN THE TEM: FUNDAMENTALS, MODERN TOOLS AND APPLICATIONS BEYOND ELEMENTAL ANALYSIS***			
12:00 - 12:30	**Yaron Amouyal** / Technion ***ATOM PROBE TOMOGRAPHY FOR ELEMENTAL ANALYSIS***			
12:30 - 13:30	**Lunch Break & Lab Tour**			
Session Chair:	**Zipora Lansky**, Technion			
13:30 - 14:00	**Zahava Barkay** / Tel-Aviv University ***CATHODOLUMINESCENCE IN SEM - RESEARCH AND APPLICATION***			
	DEMOS at The Electron Microscopy Center - MIKA			
14:00 - 14:45	**Olga Kleinerman-Saar** / Technion ***LOW ENERGIES SEM-EDS***	**Yaron Kauffmann** / Technion ***STEM EELS &EDS***	**Maria Koifman-Khristosov** / Technion ***SEM-WDS***	**Inbar Freilich** / Technion ***ATOM PROBE TOMOGRAPHY (APT)***
14:45 - 15:00	**Coffee break**			
15:00 - 15:45	**Olga Kleinerman-Saar** / Technion ***LOW ENERGIES SEM-EDS***	**Yaron Kauffmann** / Technion ***STEM EELS &EDS***	**Maria Koifman-Khristosov** / Technion ***SEM-WDS***	**Inbar Freilich** / Technion ***ATOM PROBE TOMOGRAPHY (APT)***
15:45	**Departure**			

Meeting Program - May 14th

08:30 - 09:30	Registration & Light Refreshments
OPENING SESSION - Hall A	
Session Chair:	**Tamar Segal-Peretz,** Technion - Israel Institute of Technology, ISM Chairperson
09:30 - 9:50	• Opening Remarks • Presentation of the ISM Excellence Prizes- Yael Mutsafi and Margulis Prizes • Presentation of the Eyal Shimoni Travel Scholarship and ISM Travel award to MSC2026
PLENARY SESSION- Hall A	
Session Chair:	**Leeya Engel,** Technion - Israel Institute of Technology, Head of LS Scientific Committee
9:50 - 10:30	Plenary Lecture: **Benny Geiger,** WIS Multi- dimensional view of cell- microenvironment interactions: a 5-decade journey
Session Chair:	**Tamar Segal-Peretz,** Technion - Israel Institute of Technology, ISM Chairperson
10:30-10:50	Microscopy in Israel- past, present, and future: **Martin Kessel**, Hebrew University of Jerusalem, **Ran Zalk**, Ben Gurion University of the Negev, **Ido Kaminer,** Technion - Israel Institute of Technology, Head of FI Scientific Committee,
10:50 - 11:20	***Coffee Break & Vendors Exhibition***
Session Chair:	**Adi Salomon,** Bar Ilan University, Head of MS Scientific Committee
11:20 - 12:00	Plenary Lecture: **Boaz Pokroy**, Technion Elucidating structure- function relationships in biological and bio-inspired materials
Session Chair:	**Einat Zelinger,** Hebrew University of Jerusalem
12:00 - 12:30	Posters Sound Bites
LUNCH SESSION	
12:30 – 14:00	***Lunch & Vendors Exhibition*** — **ISM GENERAL ASSEMBLY- Hall A**
13:00 - 14:00	LIFE SCIENCES POSTERS MATERIALS SCIENCE POSTERS FRONTIERS IN INSTRUMENTATIONS AND METHODS POSTERS VENDORS EXHIBITION MICROGRAPH COMPETITION

PARALLEL SESSIONS			
	Life Science **Hall M**	**Materials Science** **Hall L**	**Frontiers in Instrumentation and Methods** **Hall K**
Session chair	**Natalie Elia, BGU**	**Amnon Rothman, BGU**	**Ady Arie, TAU**
14:00 - 14:20	**Invited** **Natan Shaked, TAU** 3D LABEL-FREE IMAGING OF RAPID BIOLOGICAL CELL DYNAMICS VIA	**Invited** **Yevgeny Rakita, BGU** FROM IMAGING TO DECODING: DATA-DRIVEN ELECTRON MICROSCOPY FOR DISORDERED MATERIAL SYSTEMS	**Invited** **Ofer Kfir, TAU** 4D-STEM OF 2D MATERIALS AT LOW ELECTRON ENERGIES

	INTERFEROMETRIC MULTIPLEXING		
14:20 – 14:31	**Shani Nadav Eliyahu, BIU** **Mutsafi** NUCLEAR SPECKLES ARE REGULTORY HUBS FOR VIRAL AND HOST MRNA EXPRESSION DURING HSV-1 INFECTION	**Shai Levy, Technion** PROBING SUPERFLUORESCENT EMISSION IN PEROVSKITE QUANTUM DOTS THROUGH ULTRAFAST CATHODOLUMINESCENCE ELECTRON MICROSCOPY	**Daniel Khaykelson, WIS** **Margulis** UNSUPERVISED MACHINE LEARNING AND 4D-STEM FOR ELUCIDATING HIDDEN STRUCTURAL DISORDER IN NANOMETER SCALES
14:31 - 14:42	**Yael Noy, WIS** FROM BLACK TO WHITE: DE NOVO BIOGENESIS OF A LIGHT-SCATTERING ORGANELLE DURING PIGMENT CELL TRANSDIFFERENTIATION	**Hadar Aharon, TAU** CATHODOLUMINESCENCE ENHANCEMENT MECHANISMS IN SILICA MICROSPHERES	**Ofri Goldenberg, Technion** PHYSICS-INFORMED SELF-SUPERVISED GENERATIVE MODEL FOR 3D LOCALIZATION MICROSCOPY
14:42 - 14:53	**Shani Tcherner Elad, Technion** AN ENGINEERED PLATFORM TO STUDY THE INFLUENCE OF EXTRACELLULAR MATRIX NANOTOPOGRAPHY ON CELL ULTRASTRUCTURE	**Roey Ben David, Fritz Haber Institute** OPERANDO SCANNING ELECTRON MICROSCOPY STUDY OF NICKEL FOAM CATALYST DURING AMMONIA DECOMPOSITION REACTION	**Eitan Balken, HUJI** E+: SOFTWARE FOR HIERARCHICAL MODELING OF ELECTRON SCATTERING FROM COMPLEX STRUCTURES
14:53 - 15:04	**Ran Tivony, BGU** QUANTIFYING ION TRANSPORT AND ELECTROCHEMICAL GRADIENTS IN SYNTHETIC CELL MEMBRANES	**Amram Azulay, TAU** CRYSTAL STRUCTURE METROLOGY USING SCANNING TRANSMISSION ELECTRON MICROSCOPY	**Hussam Salameh, HUJI** TOWARDS A COMPACT SUB-100-MEV SEM ELECTRON SPECTROMETER
15:04 - 15:15	**Avital Wagner, Radboud University Medical Center** LOW-DOSE LIQUID-PHASE ELECTRON MICROSCOPY OF BONE MINERALIZATION	**Sapir Rappoport, Technion** INTERACTIONS OF AMPHIPHILIC INTERPOLYELECTROLYTE COMPLEXES WITH LIPOSOME MEMBRANES STUDIED BY ON-THE-GRID PROCESSING CRYO-TRANSMISSION ELECTRON MICROSCOPY	**Ben Lich, Delmic BV** SUPER-RESOLVED INTEGRATED CRYO-FLUORESCENCE IMAGING ON LAMELLA FOR PRECISION CRYO-ET

15:15 - 15:35	**Invited** **Dvir Harris, Technion** BOOST AND BRAKE: ONE SWITCH THAT TUNES PHOTOSYNTHESIS	**Invite** **Oren Lahav, KLA** OVERLAY METROLOGY CHALLENGES IN ADVANCED SEMICONDUCTOR NODES	**Invited** **Assaf Zaritsky, BGU** ENABLING NON-INVASIVE, MULTIPLEXED, LONG-TERM OBSERVATION OF CELLULAR PROCESSES VIA LABEL-FREE LIVE IMAGING AND IN SILICO LABELING
15:35 - 16:00	***Coffee Break & Vendors Exhibition***		

PARALLEL SESSIONS

	Life Sciences Hall M	**Materials Science Hall L**
Session chair	**Gili Bisker, TAU**	**Assaf Gal, WIS**
16:00-16:20	**Invited** **Liron David, BGU** DYING TO PROTECT – NINJURINS, THE HEROES OF THE IMMUNE SYSTEM	**Invited** **Alexandra Tayar, WIS** VISCOELASTIC CONTROL OF ACTIVE FLOWS IN BIOINSPIRED MOTOR-FILAMENT NETWORKS
16:20-16:31	**Yuval Ebenstein, TAU** CONTINUOUSLY CONTROLLED SPECTRAL (COCOS) MICROSCOPY: FROM HIGH-THROUGHPUT SINGLE MOLECULE MULTIPLEXING TO HIGH-RESOLUTION MULTI-COLOR IMAGING	**Tali Lemcoff, BGU** DAMSELFLIES OVERCOME COLOR SATURATION BARRIERS OF PHOTONIC GLASSES VIA PIGMENT LOADING AND REFRACTIVE INDEX MODULATION
16:31-16:42	**Geffen Rosenberg, TAU** QUANTIFYING POPULATION REVERSIBILITY OF SENSOR PERFORMANCE IN MULTI-CYCLE SINGLE-SENSOR RECOVERY ASSAY	**Hadar Nasi, WIS** CORRELATIVE IMAGING CAPTURES A FUSION MECHANISM AS THE ORIGIN OF SINGLE-CRYSTALS WITH MULTIDOMAIN APPEARANCE
16:42-16:53	**Peter Kirchweger, WIS** ADVANCED CRYO-STET IMAGING: FISHING FOR THE MTDNA IN SITU	**Alon Krause, BIU** MORPHOLOGY-ACTIVATED SECOND-HARMONIC GENERATION IN METASTABLE PARA-RED PLATE CRYSTALS
16:53-17:04	**Esraa Nsasra, BGU** THE LAST 2 HOURS BEFORE DEATH: MULTISCALE SPATIOTEMPORAL CHARACTERIZATION OF COLLECTIVE CELL DEATH	**Shirel Kleiner, TAU** OPTICAL SENSORS FOR PROBING HYDROGELS AND THE BIOLOGICAL ENVIRONMENT

17:04-17:15	**Inbar Yosibash, TAU** A VERSATILE GPMV-IMAGING PLATFORM FOR QUANTITATIVE ANALYSIS OF RECEPTOR BINDING AND MEMBRANE FUSION	**Martyna Polak, AGH university** ELECTROSPUN PLLA COMPOSITE FIBERS WITH rGO AND MXene: SURFACE CHARGE MODULATION AND OSTEOBLAST RESPONSE
17:11-17:35	**Invited** **Shifra Lansky, WIS** OLIGOMER PLASTICITY: AN EMERGING NEW MECHANISM IN MEMBRANE PROTEINS?	**Invited** **Angelica Elkan, TAU** MECHANISM GUIDED CRYSTAL GROWTH: FROM MOLECULAR MECHANISIMS TO MATURE CRYSTALS WITH DESIGNED MORPHOLOGIES

17:35 - 18:00	***Closing Remarks + Best Poster & Best Micrograph Awards***
18:00	***Departure***

POSTERS - Life Sciences

P-1 RIBOSOME–COPPER INTERACTIONS IN CRYO-EM: GRID-DERIVED ARTIFACTS AND IMPLICATIONS FOR METAL HOMEOSTASIS

Aliza Fedorenko[1], Andre Rivalta[1], Anat Bashan[1], Jiro Kondo[2], Pascal Auffinger[3], Ada Yonath[1]
[1]*Chemical and Structural Biology, Weizmann Institute of Science, Rehovot*
[2]*Department of Materials and Life Sciences, Sophia University, Tokyo*
[3]*Université de Strasbourg, Strasbourg*

P-2 INVESTIGATING GENE EXPRESSION RE-ESTABLISHMENT POST-MITOSIS AND THE ROLE OF NUCLEAR BODY ASSEMBLY IN REGULATING MRNA TRANSCRIPTION AND EXPORT

Alon Boocholez[1], Heba Zoubi[1], Shahar Hammer[1], Yaron Shav-Tal[1]
Faculty of Life Sciences, Bar-Ilan University, Ramat Gan

P-3 SWIFT NUCLEAR TRANSPORT AND EXPORT OF HSP MRNAS DURING HEAT SHOCK IN LIVING CELLS

Mohammad Khaled Atrash[1], Andrew S. Belmont, Andrew S. Belmont[2], Yaron Shav-Tal, Yaron Shav-Tal[1]
[1]*The Mina and Everard Goodman Faculty of Life Sciences, Bar-Ilan University, Ramat-Gan*
[2]*Department of Cell and Developmental Biology, University of Illinois at Urbana Champaign, Urbana Champaign, Illinois*

P-4 ALTERED AUDITORY PERCEPTION IN AUTISM SPECTRUM DISORDER

Netta Baram[1], Anita Temnogorod[1], Tal Levi[1], Jennifer Resnik[1,2]
[1]*Life Sciences Department, Ben-Gurion University, Be'er Sheva*
[2]*The Zelman Center for Neuroscience, Ben-Gurion University, Be'er Sheva*

P-5 MINIMAL ESCRT-III MACHINERY FROM ASGARD ARCHAEA DRIVES VESICLE BUDDING

Dikla Nachmias[1], Tom Bitton[1,2], Anat Nativ-Roth[2], Alexander Upcher[2], Ran Zalk[2], Philipp Radler[3], Christa Schleper[3], Natalie Elia[1]
[1]*Life Sciences, Ben-Gurion University of the Negev, Beer Sheva 84105*
[2]*Ilse Katz Institute for Nanoscale Science and Technology, Ben Gurion University of the Negev, Beer Sheva, 84105*
[3]*Archaea Biology and Ecogenomics Unit, University of Vienna, Djerassiplatz 1030*

P-6 THE ORIGIN OF LIFE: STRUCTURAL AND FUNCTIONAL INSIGHTS OF THE PROTORIBOSOME

Disha Gajanan Hiregange[1], Franklin John[1,2], Alla Falkovich[3], Roman Kamyshinsky[3], Tanaya Bose[1,4], Gil Fridkin[5], Ella Zimmerman[1], Anat Bashan[1], Ada Yonath[1]
[1]*Department of Chemical and Structural Biology, Weizmann Institute of Science, Rehovot*
[2]*Department of Chemistry, Sacred Heart College, Kochi, Kerala*
[3]*Department of Chemical Research Support, Weizmann Institute of Science, Rehovot*
[4]*Structural Biology & Bioinformatics, CSIR-Indian Institute of Chemical Biology, West Bengal*
[5]*Department of Organic Chemistry, Israel Institute for Biological Research, Rehovot*

P-7 MITOCHONDRIAL AND CELLULAR REMODELING DURING LEISHMANIA METACYCLOGENESIS REVEALED BY ELECTRON MICROSCOPY

Eyar Doron[1], Noam Reuven Tauba[1], Irit Dahan[1], Iris Grossman-Haham[1]
Life Sciences, Ben-Gurion University of the Negev, Beer Sheva

P-8 **INTEGRATING LIVE-CELL MICROSCOPY AND MACHINE LEARNING TO UNCOVER THE ROLES OF NON-CANONICAL MICROTUBULES BINDING OF KINESIN-5 MOTORS**

Omer Bushusha[1], Karin Pliner[1], Neta Yanir[1], Mayan Sadan[1], Daniel Sevilla Sánchez[2], Leah Gheber[1,2]
[1]*Department of Chemistry, Ben-Gurion University of the Negev, Beer-Sheva*
[2]*Ilse Katz Institute for Nanoscale Science and Technology, Ben-Gurion University of the Negev, Beer-Sheva*

P-9 **THE EVOLUTIONARILY CONSERVED N' OF ESCRT-III PROTEINS FROM ASGARD ARCHAEA MEDIATES DNA BINDING, POLYMERIZATION AND MEMBRANE REMODELING**

Shahar Grushka[1], Noam Guetta[1], Dikla Nachmias[1], Erez Zerbib[1], Alexander Upcher[1], Ran Zalk[1], Gal Halbi[1], Anne Bernheim[1], Natalie Elia[1]
Life Scinces, Ben Gurion University of the Negev, Beer Sheva

P-10 **INVESTIGATING SPATIAL-TEMPORAL RNA-BINDING PROTEIN RECRUITMENT TO THE NASCENT TRANSCRIPT AND MRNP FORMATION**

Hila Hamiel Levi[1,2], Yaron Shav-Tal[1,2]
[1]*The Goodman Faculty of Life Sciences, Bar-Ilan University, Ramat-Gan*
[2]*Institute of Nanotechnology and Advanced Materials, Bar-Ilan University, Ramat-Gan*

P-11 **WHOLE-BODY 3D STRUCTURAL AND CYTOSKELETAL CHARACTERIZATION OF HYDRA REGENERATION**

Iris Pasvinter[1], Liora Garion[1], Kinneret Keren[1]
Physics, Technion - Israel Institute of Technology, Haifa

P-12 **MECHANICAL STRESS REGULATES LOCAL DIFFERENTIATION AND REGENERATION PATTERNS IN THE MAMMALIAN VESTIBULAR SYSTEM**

Shahar Kasirer[1,2], Michal Shraga[1,2], Tim Dullweber[3], Olga Loza[1], David Sprinzak[1]
[1]*Biochemistry Department, School of Neurobiology, Biochemistry & Biophysics, Wise Faculty of Life Sciences, Tel Aviv University, Tel Aviv*
[2]*School of Physics and Astronomy, Exact Sciences Faculty, Tel Aviv University, Tel Aviv*
[3]*Biocentrum, Basel University, Basel*

P-13 **A NOVEL SYSTEMATIC COLLECTION OF YEAST STRAINS UNCOVERS CONSERVED KEY METABOLIC PROTEINS AS PEROXISOMAL RESIDENTS**

Lior Peer[1], Nitya Aravindan[2], Jenny Keller[3], Eden Yifrach[1], Dekel Yahav Har-Shai[1], Rubén Fernández-Busnadiego[3], Doron Rapaport[2], Einat Zalckvar[4], Maya Schuldiner[1]
[1]*Weizmann Institute of Science, Rehovot*
[2]*Interfaculty Institute of Biochemistry, University of Tübingen, Tübingen*
[3]*Institute of Neuropathology, University Medical Center Göttingen, Göttingen*
[4]*The Mina and Everard Goodman Faculty of Life Sciences, Bar-Ilan University, Ramat-Gan*

P-14 **DECIPHERING THE CYTOSKELETAL REGULATION OF MATRIX-PROTEIN TRAFFICKING DURING SEA URCHIN SKELETOGENESIS**

Nirikshan Mandal[1], Tsvia Gildor[1], Smadar Ben-Tabou de-Leon[1]
Department of Marine Biology, University of Haifa, Haifa

P-15 **THREE-DIMENSIONAL MUSCLE ULTRASTRUCTURE IN FLIES AND MICE LACKING SARCALUMENIN EXPRESSION**

Sergey Mursalimov[1], Ilan Zemski[1], Nechama Sasson[1], Eyal Schejter[2], Yael Alon[1], Ori Avinoam[1]
[1]*Department of Biomolecular Sciences, Weizmann Institute of Science, Rehovot*
[2]*Department of Molecular Genetics, Weizmann Institute of Science, Rehovot*

P-16 PHYSICOCHEMICAL PROPERTIES OF MICROCALCIFICATION-MIMETIC CALCIUM PHOSPHATE NANOPARTICLES DICTATE CELLULAR UPTAKE AND CYTOTOXICITY IN BREAST CANCER CELLS

Yarden Nahmias[1], Gabriel Yazbek Grobman[1], Netta Vidavsky[1]
Chemical Engineering, Ben-Gurion University of the Negev, Beer Sheva

P-17 LS&E INFRASTRUCTURE CENTER: AN INTEGRATED MULTIMODALITY CORE FACILITY FOR STATE-OF-THE-ART MICROSCOPY IMAGING

Nitsan Dahan[1], Tally Chalolachvilli Mergener[1], Maayan Duvshani-Eshet[1]
The Life-Sciences and Engineering (LS&E) Infrastructure Center, Technion-Israel Institute of Technology, Haifa

P-18 INTERCELLULAR AND DUAL-SITE INHIBITION OF A BITTER TASTE GPCR

Nitsan Dallal[1]
Institute of Biochemistry, Food Science and Nutrition, The Hebrew University, Rehovot

P-19 INTEGRATED FABRICATION OF EM GRIDS FOR ACTIVE AND PASSIVE CELL MORPHOLOGY CONTROL

Noa Ben-Asher[1], Amit Avrahami[1], Leeya Engel[1]
Faculty of Mechanical Engineering, Technion - Israel Institution of Technology, Haifa

P-20 SYMMETRIC CANCER SPHEROID-FIBROBLAST 3D ORGANIZATION REVEALED AND CHARACTERIZED BY PSF-ENGINEERED HIGH-THROUGHPUT MICROSCOPY

Noam Zoref[1], Maytal Avrashami[1], Nadav Opatovski[2], Paul Keselman[3], Yosi Shamay[1], Yoav Shechtman[1,2,4]
[1]*Faculty of Biomedical Engineering, Technion - Israel Institute of Technology, Haifa*
[2]*Russell Berrie Nanotechnology Institute, Technion - Israel Institute of Technology, Haifa*
[3]*Sartorius Stedim North America Inc., NY*
[4]*Faculty of Electrical and Computer Engineering, Technion - Israel Institute of Technology, Haifa*

P-21 FUNCTIONAL ANALASIS OF THE N-TERMINAL REGION OF ASGARD CHMP4-7 REVEALS ITS ROLE IN DNA BINDING

Noy Goren[1], Dikla Nachmias[1], Noam Guetta[1], Natalie Elia[1]
Life Science, Ben-Gurion University of the Negev, Be'er Sheva

P-22 INVOLVEMENT OF ESCRT-III IN MICRONUCLEI

Noy Hanukayev[1], Dikla Nachmias[1], Venkata-Narasimha Kadali[2], Ofer Shoshani[2], Natalie Elia[1]
[1]*Department of Life Sciences, Ben-Gurion University of the Negev, Beer Sheva*
[2]*Department of Biomolecular Sciences, Weizmann Institute of Science, Rehovot*

P-23 SPATIAL MULTI-OMICS AND IMAGE ANALYSIS ILLUMINATE UNIQUE ZONATION PATTERNS AND DISEASE MECHANISMS

Ofra Golani[1], Oran Yakubovsky[2], Roy Novoselsky[2], Vishnu Mohan[2], Shiri Karagach[2], Tamar Gieger[2], Shalev Itzkovitz[2]
[1]*Department of Life Sciences Core Facilities, Weizmann Institute of Science, Rehovot, Israel*
[2]*Department of Molecular Cell Biology, Weizmann Institute of Science, Rehovot, Israel*

P-24 THE TECHNION CENTER FOR ELECTRON MICROSCOPY OF SOFT MATTER

Olga Kleinerman[1], Zipora Lansky[1], Ellina Kesselman[1]
Chemical Engineering, Technion, Haifa

P-25 **DEEP LEARNING BASED CORRECTION OF OPTICAL ABERRATIONS IN SINGLE MOLECULE LOCALIZATION MICROSCOY**

Omer Gottlieb[1], Yoav Shechtman[1]
Biomedical Engineering, Technion - Isreal Institute of Technology, Haifa

P-26 **α-SYNUCLEIN CONDENSATES AND INTERACTIONS IN CELLS USING ADVANCED FLUORESCENCE MICROSCOPY**

Paz Drori[1], Yair Razvag[1], Joanna Zamel[1], Shalhevet Klemfner[2], Eran Meshorer[2], Nir Kalisman[1], Eitan Lerner[1]
[1]*The Alexander Silberman Institute for Life Sciences, The Hebrew University of Jerusalem, Jerusalem*
[2]*Department of Genetics, The Hebrew University of Jerusalem, Jerusalem*

P-27 **QUANTITATIVE LIVE IMAGING OF ACTOMYOSIN-DRIVEN MINERAL-BEARING VESICLE TRAFFICKING DURING BIOMINERALIZATION**

Prashant Tewari[1], Tsvia Gildor[1], Smadar Ben Tabou de Leon[1]
Department of Marine Biology, University of Haifa, Haifa

P-28 **MITOCHONDRIAL CONTROL OF PURINE FLUX SHAPES INTRACELLULAR GUANINE CRYSTAL FORMATION**

Rachael Deis[1], Tali Lerer-Goldshtein[1], Katya Rechav[1], Neta Varsano[1], Avi Baram[1], Shifra Ben-Dor[1], Zohar Eyal[1], Meital Kupervaser[1], Ziv Porat[1], Dvir Gur[1]
Weizmann Institute of Science, Rehovot

P-29 **MICROTUBULE INNER PROTEINS SHAPE THE BIOCHEMICAL LANDSCAPE OF CILIARY MICROTUBULES**

Rachel Mary Clementina Joseph Raj[1], Shulamit Ben-Uliel[1], Mohammed Aboraya[1], Ron Orbach[1]
Azrieli Faculty of Medicine, Bar-Ilan University, Safed

P-30 **CRYO-EM FOR BIOLOGICAL AND OTHER SOFT MATERIALS**

Ran Zalk[1]
Ilse Katz Institute for Nanoscale Science & Technology, Ben-Gurion University of the Negev, Beer Sheva

P-31 **THE STRUCTURAL AND DYNAMIC MECHANISMS OF THE TON MOTOR COMPLEX**

Shahar LYUBINSKY[1], Shifra Lansky[1]
Department of Chemical and Structural Biology, The Weizmann Institute of Science, Rehovot

P-32 **TOMO4D: 4D-STEM TOMOGRAPIC RECONSTRUCTION**

Shai Kiriati[1], Jose-Jesus Fernandez[2,3], Michael Elbaum[1]
[1]*Weizmann Institute of Science, Rehovot*
[2]*CINN-CSIC, Oviedo*
[3]*ISPA, Asturias*

P-33 **CRYO-EM AND GRAPH REPRESENTATION REVEAL AN EVOLUTIONARILY CONSERVED ASSEMBLY PROGRAM IN PSEUDO-SYMMETRIC OLIGOMERS**

Daniel Stein, **Shiran Dror**[1,2], Ran Zalk, Anat Sahar, Raz Zarivach, Gabriel A. Frank
[1]*National Institute for Biotechnology in the Negev, Beer Sheva*
[2]*National Institute for Biotechnology in the Negev, Beer Sheva*

P-34 **THE EFFECT OF CARBON RESIDUE LENGTH ON GIANT UNILAMELLAR VESICLE MEMBRANE PERMEABILITY**

Stav Yefet[1]
chemical engineering, Ben Gurion University, Gan Yavne, Isreal

P-35 UNRAVELLING THE MOLECULAR MECHANISMS OF BIOGENIC PURINE CRYSTALLIZATION IN YEAST

Sukanya Bera[1], Tali Leler Goldshtein[1], Zohar Eyal, Zohar Eyal[1], Sourabh Bera[1], Avi Baram[1], Orna Dahan[1], Iddo Pinkas[2], Dvir Gur*[1]
[1]*Department of Molecular Genetics, Weizmann Institute of Science, Rehovot*
[2]*Department of Chemical Research Support, Weizmann Institute of Science, Rehovot*

P-36 ADAPTING ITERATIVE EXPANSION MICROSCOPY FOR FACILITY-BASED SUPER-RESOLUTION IMAGING SERVICES

Tom Biton[1,2], Dikla Nachmias[2], Ran Zalk[1], Marianna Zaretsky[2], Amir Aharoni[2], Alexsandra Tsitrin[1], Natalie Elia[2], Efrat Forti[1]
[1]*Ilse Katz Institute for Nanoscale Science and Technology, Ben-Gurion University of the Negev, Be'er-Sheva*
[2]*Faculty of Natural Sciences, Ben-Gurion University of the Negev, Be'er-Sheva*

P-37 QUANTITATIVE ANALYSIS OF CHROMATIN BIOPHYSICS REVEALS LAMIN A AS A KEY REGULATOR OF NUCLEAR ORGANIZATION

Wajdi Nicola[1], Vered Levi[2], Irina Bronshtein[1], Yuval Garini[1]
[1]*Biomedical Engineering, Technion, IIT, Haifa*
[2]*Physics Department& Instite of Nanotechnology, Bar Ilan University, Ramat Gan*

P-38 TUMOR-SUPPRESSIVE ROLE OF CALCIUM OXALATE DIHYDRATE IN BREAST CANCER

Gabriel Yazbek Grobman[1], Yarden Nahmias[1], Shiran Dror[2], Liron Levin[2], Netta Vidavsky[1,2]
[1]*Department of Chemical Engineering, Ben-Gurion University of the Negev, Beer Sheva*
[2]*Ilse Katz Institute for Nanoscale Science and Technology, Ben-Gurion University of the Negev, Beer Sheva*

P-39 PH VARIATIONS ENABLE GUANINE CRYSTAL FORMATION WITHIN IRIDOSOMES

Zohar Eyal[1], Rachael Deis[1], Anna Gorelick-Ashkenazi[1], Yuval Barzilay[1], Yonatan Broder[1], Asher Perry Kellum[1], Neta Varsano[1], Michal Hartstein[1], Andrea Sorrentino[2], Ron Rotkopf[1], Ifat Kaplan-Ashiri[1], Katya Rechav[1], Rebecca Metzler[3], Lothar Houben[1], Leeor Kronik[1], Peter Rez[4], Dvir Gur[1]
[1]*Weizmann Institute of Science, Rehovot, Israel, Please Select*
[2]*Mistral Beamline, Alba Synchrotron Light Source, Cerdanyola Del Vallès*
[3]*Colgate University, Hamilton, New York*
[4]*Arizona State University, Tempe, Arizona*

P-40 RECONSTITUTION OF THE PARAFLAGELLAR ROD SCAFFOLD IN KINETOPLASTID PARASITES

Shaked Ambar Cohn[1], Irit Dahan[1], Tom Biton[2], Iris Grossman Haham[1]
[1]*Department of Life Science, Ben Gurion University of the Negev, Beer Sheva*
[2]*The Ilse Katz Institute for Nanoscale Science and Technology, Ben Gurion University of the Negev, Beer Sheva*

P-41 IN SITU IMAGING OF NEMATOCYST RESPONSES TO POST-STING TREATMENTS

Carmel Danino Gozlan[1] ,Dror Angel[1] [1]
Humanities, Applied Marine Biology and Ecology Research Laboratory, University of Haifa, Haifa, Israel

POSTERS - Materials Science

P-42 MODULATING THE CURVATURE OF PROTEIN SELF-ASSEMBLED SPIRAL NANOTUBULES

Ariel Cohen[1], Itai Ben-Nun[1], Israel Ringel[3], Ran Zalk[4], Yael Levi-Kalisman[2], Gabriel A. Frank[4], Uri Raviv[1]
[1]*Institute of Chemistry, The Hebrew University of Jerusalem, Jerusalem*
[2]*The Harvey M. Krueger Family Center for Nanoscience and Nanotechnology, The Hebrew University of Jerusalem, Jerusalem*
[3]*Institute for Drug Research, The School of Pharmacy, Faculty of Medicine, The Hebrew University of Jerusalem, Jerusalem*
[4]*Department of Life Sciences, Ben-Gurion University of the Negev, Beer-Sheva*

P-43 IN-SITU ELECTRON MICROSCOPY FOR LOCAL INTERFACIAL ELECTRICAL CHARACTERIZATION OF HEUSLER ALLOY FE2VAL WITH ITS METALLIC CONTACTS

Avia Greenberg[1], Amram Azulay[1], Hanna Bishara[1]
The Iby and Aladar Fleischman Faculty of Engineering, Department of Materials Science and Engineering, Tel -Aviv university, Tel-Aviv

P-44 ELECTRON MICROSCOPY FOR FAILURE ANALYSIS AND PROCESS WINDOW IDENTIFICATION IN ION MILLING OF SUPERCONDUCTING INTERFACES

Doron Gurovich[1], Or Ben Ishayah[2], Dr. Sergei Remennik[3], Dr. Anna Radko[3], Atzmon Vakahi[3], Maurice Saidian[1], Roee Barkai[4]
[1]*Center for Nanoscience and Nanotechnology, Unit for Nanofabrication (UNF), Hebrew University Jerusalem, Jerusalem*
[2]*Macroscopic Quantum Coherence Lab (QCL), Racah Institute of Physics, Hebrew University Jerusalem, Jerusalem*
[3]*Center for Nanoscience and Nanotechnology, Unit for Nano Characterization, Hebrew University Jerusalem, Jerusalem*
[4]*Quantum Optics and Quantum Information Laboratory, Racah Institute of Physics, Hebrew University Jerusalem, Jerusalem*

P-45 RAMAN MICROSCOPY FOR IMAGING CHEMICAL PHASE HETEROGENEITIES IN NICKEL HYDROXIDE ELECTRODES

David Ellis[1], Avihay Ben-Shitrit[1], Elena Praznikov[1], Avner Rothschild[1]
Materials Science and Engineering, Technion Israel Institute of Technology, Haifa

P-46 ANGLE RESOLVED FULL STOKES POLARIZATION MEASUREMENT OF SMITH PURCELL RADIATION

Feiyan Zhao[1], Zahava Barkay[2], Ady Arie[1,2]
[1]*School of Electrical and Computer Engineering, Fleischman Faculty of Engineering, Tel Aviv University, Tel Aviv*
[2]*Jan Koum Center for Nanoscience and Nanotechnology, Tel Aviv University, Tel Aviv*

P-47 MIXED PHASE TIO2 NANOTUBES SUPPORT FOR ENHANCED HER IN NEAR-NEUTRAL PH ELECTROLYTE

Matan Sananis, Elena Davydova, **Anna Breytus**[1], Avner Rothschild
Materials Science and Engineering, Technion - Israel Institute of Technology, Haifa

P-48 CHEMOELASTIC EFFECTS, PHASE EQUILIBRIA, AND UPHILL DIFFUSION IN Cu-Pd NANOPARTICLES

Idan Klein[1], Feitao Li[1], Eugen Rabkin[1]
Department of Materials Science and Engineering, Technion - Institute of Technology, Haifa

P-49 **LET IT BE: DESIGN AND HIGH-RESOLUTION CRYO-EM STRUCTURE OF AN ENGINEERED PROTEIN ASSEMBLY**

Shaked Katzelnick[1], Yuval Shoham[1], Dganit Danino[1,2]
[1]*Faculty of Biotechnology and Food Engineering, Technion-Israel Institute of Technology, Haifa, North*
[2]*Department of Biotechnology and Food Engineering, Guangdong Technion-Israel Institute of Technology, Shantou, Guangdong*

P-50 **ENABLING NANOSCALE EXAMINATION OF TWO-DIMENSIONAL MATERIALS – Ti3C2Tx MXENES – WITH 4D-STEM**

Kirill Sobolev[1], Mridul Kumar[1], Alexander Upcher[2], Vladimir Ezersky[2], Yevgeny Rakita[1,2]
[1]*Materials Engineering, Ben Gurion University of the Negev, Beer Sheva*
[2]*Ilse Katz Institute for Nanoscale Science and Technology, Ben Gurion University of the Negev, Beer Sheva*

P-51 **NANOSCALE POLY(A)MORPHISM OF PVDF THIN FILMS**

Lior Snarski[1], Boris Rybtchinski[1]
Department of Molecular Chemistry and Materials Science, Weizmann Institute of Science, Rehovot

P-52 **PYSTEMLAB: A WEB APPLICATION FOR REAL-TIME 4D-STEM SPACE NAVIGATION, DRIFT CORRECTION, AND UNSUPERVISED PHASE CLUSTERING FOR NANOSCALE PHASE DISCOVERY**

Mridul Kumar[1], Kirill Sobolev[1], Yevgeny Rakita[1,2]
[1]*Materials Engineering, Ben-Gurion University of the Negev, Be'er Sheva*
[2]*Ilse Katz Institute for Nanoscale Science, Ben-Gurion University of the Negev, Be'er Sheva*

P-53 **MAPPING THE CRYSTALLIZATION MECHANISM OF POLYLACTIC ACID UNDER MELT FLOW CONDITIONS VIA 4D-STEM**

Nadav Yahalom[1], Lior Snarsky[1], Boris Rybtchinski[1]
Molecular Chemistry and Materials Science, Weizmann Institute of Science, Rehovot

P-54 **KELVIN PROBE FORCE MICROSCOPY OF CoFe2O4-BaTiO3 CORE-SHELL NANOWIRES UNDER MAGNETIC FIELD**

Neta Gal[1], Yonatan Calahorra[1]
Faculty of Materials Science and Engineering, Technion- Israel Institute of Technology, Haifa

P-55 **DISLOCATIONS INDUCED PERIODIC VARIATIONS OF INTERPLANAR SPACINGS OF 9R STRUCTURE IN CU**

Saja Sarhan[1], Amram Azulay[1], Hanna Bishara[1]
Department of Materials Science and Engineering, The Iby and Aladar Fleischman Faculty of Engineering, Tel Aviv University, Tel Aviv

P-56 **THE EFFECT OF FRAGRANCE AND SALT MOLECULES ON SURFACTANT SELF-AGGREGATION IN AQUEOUS SOLUTIONS STUDIED BY CRYO-TEM**

Sapir Lifshiz-Simon[1], Yeshayahu Talmon[1]
Chemical Engineering and the Russell Berrie Nanotechnology Institute (RBNI), Technion – Israel Institute of Technology, Haifa

P-57 **STUDYING FLUORESCENT PROPERTIES OF OLIVE CARBON DOTS USING TIME-RESOLVED FLUORESCENCE MEASUREMENTS**

Saidvaliev Ulugbek[1], Dror Fixler[1], Nataliia Dudchenko[2]
[1]*Faculty of Engineering, Tel Aviv University, Tel Aviv*
[2]*Bar Ilan Institute of Nanotechnology & Advanced Materials, Bar Ilan University, Ramat Gan*

P-58 **HARNESSING MICROALGAE FOR THE BIOSYNTHESIS OF MOLECULAR CRYSTALS**

Avital Wagner, Noam Margalit, Avital Wagner, Noam Margalit, Alexander Upcher, **Yahel Fishman**[1], Mark Baranov, Mark Baranov, Einat Nativ-Roth, Colan E. Hughes, Benson M. Kariuki, Johannes S. Haataja, Einat Nativ-Roth, Lukas Schertel, Jonathan R. Yates, Kenneth D.M. Harris, Shashanka S. Indri, Allen R. Place, Peter Mojzes, Benjamin A. Palmer, Colan E. Hughes, Kenneth D.M. Harris, Allen R. Place, Benson M. Kariuki, Peter Mojzes, Benjamin A. Palmer, Johannes S. Haataja, Lukas Schertel, Jonathan R. Yates, Alexander Upcher
Department of Chemistry, Ben-Gurion University of the Negev, Beer-Sheba

P-59 **AMORPHOUS SILICON NITRIDE FOR TEM PHASE MASKS AND MEMBRANES: MEAN INNER POTENTIAL AND MEAN FREE PATHS**

Yair Yakov[1], Amram Azulay[1], Peter Rez[2], Lothar Houben[3], Amit Kohn[1]
[1]*Department of Materials Science and Engineering, The Iby and Aladar Fleischman Faculty of Engineering, Tel Aviv University, Tel Aviv 6997801*
[2]*Department of Physics, Arizona State University, Tempe, AZ 85287*
[3]*Department of Chemical Research Support, Weizmann Institute of Science, Rehovot 7610001*

P-60 **MECHANICAL PROPERTIES OF DISORDERED Fe-Co NANOPARTICLES**

Yarden Nathan Yadgar[1]
Materials Science and Engineering, Technion Institue, Israel, Haifa

P-61 **ENHANCING COMPOSITE MATERIALS PERFORMANCE AT ELEVATED TEMPERATURES USING ATOMIC LAYER DEPOSITION**

Eden Elazar[1,2], Tamar Gitli[2], Erez Zemel[2], Tamar Segal-Peretz[1]
[1]*Department of Chemical Engineering, The Technion - Israeli Institute of Technology, Haifa*
[2]*Rafael - Advanced Defense Systems Ltd., Haifa*

POSTERS - Frontiers in Instrumentation and Methods

P-62 **END-TO-END JOINT OPTIMIZATION OF Z-ENCODING PHASE MASK AND Z-STACK RECONSTRUCTION FOR SINGLE-SHOT 3D FLUORESCENCE MICROSCOPY**

Danielle Sapir[1], Ori Rafael Cohen[2], Leen Ileimi[2], Onit Alalouf[2], Yoav Shechtman[1,2]
[1]*ECE, Technion, Haifa, Haifa*
[2]*BME, Technion, Haifa, Haifa*

P-63 **IMAGING ULTRAFAST MODAL ENERGY REDISTRIBUTION IN $CSPBBR_3$ NANOLASERS**

Tal Fishman[1], Tetsuro Katayama[3], Tatsuya Fujii[4], Betty Shamaev[2], Yehonadav Bekenstein[2], Ido Kaminer[1]
[1]*Electrical and Computer Engineering (ECE), Technion, Haifa*
[2]*Materials Science and Engineering (MSE), Technion, Haifa*
[3]*Institute of Post-LED Photonics, Tokushima University, Tokushima*
[4]*Graduated school of Science and technology, Tokushima University, Tokushima*

P-64 **INVERSE-DESIGN OF A SUB-RELATIVISTIC DIELECTRIC LASER ACCELERATOR ON A CHIP**

Grigorii Kurnikov[1], Roy Shiloh[1]
The Institute of Applied Physics, The Hebrew University of Jerusalem, Jerusalem

P-65 **BRIGHTFIELD SNAPSHOT THREE-DIMENSIONAL MICROSCOPY: TOWARDS IN VIVO IMAGING**

Leen Ileimi[1], Yoav Shechtman[1,2]
[1]*Faculty of Biomedical Engineering, Technion, Haifa*
[2]*Faculty of Electrical and Computer Engineering, Technion, Haifa*

P-66 50TH ANNIVERSARY OF THE 6TH EUROPEAN CONGRESS ON ELECTRON MICROSCOPY HELD IN JERUSALEM SEPTEMBER 14-20, 1976

Martin Kessel[1,2,3]
Institute of Microbiology, Hebrew University of Jerusalem, Jerusalem, Jerusalem
Lab of Cell Biology, National Institutes of Health, National Cancer Institute, Bethesda, Maryland
Visiting Scientist, Chemical and Biological Physics, Weizmann Institute of Science, Rehovot

P-67 AUTOMATED CRYSTAL ORIENTATION MAPPING ACROSS DIFFERENT COCCOLITHS USING 4D-STEM

Rebecca Leghziel[1], Lia Addadi[1], Assaf Gal[1], Lothar Houben[1]
Plant and Environmental Sciences, Weizmann Institute of Science, Rehovot, Israel

P-68 ELASTIC QUANTUM COUPLING BETWEEN FREE ELECTRONS AND PHOTONS

Dingguo Zheng[1], Ofer Kfir[1]
School of Electrical Engineering, the Iby and Aladar Fleischman Faculty of Engineering, Tel Aviv University, Tel Aviv

P-69 A NEW LOOK AT DARK-FIELD TEM ORIENTATION MAPPING: AN EFFICIENT SOLUTION FOR CHARACTERIZATION OF NANOCRYSTALLINE MATERIAL

Anastasiya Reveguk[1], Amram Azulay[1], Ilan Goldfarb[1], Amit Kohn[1]
Department of Materials Science and Engineering, The Iby and Aladar Fleischman Faculty of Engineering, Tel Aviv University, Tel Aviv, Israel

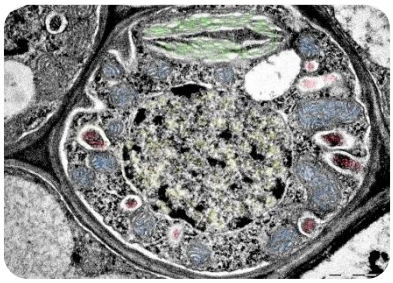
Life Sciences:

P-70 DISPERSED RELEASE OF LYTIC GRANULES BY CAR-T CELLS LEADS TO DISTANT AND WIDE-SPREAD KILLING OF TARGET CANCER CELLS

Amit Ifrach[1], Julia Sajman[1,2], Oren Yakovian[1], Eman Gharra[3],Yariv Greenshpan[3], Angel Porgador[3], Eilon Sherman[1*]
1 Racah Institute of Physics, The Hebrew University, Jerusalem, Israel, 91904
2 Jerusalem College of Technology, Jerusalem, Israel 91160
3 The Shraga Segal Department of Microbiology, Immunology, and Genetics, Faculty of Health Sciences, Ben-Gurion University of the Negev, Beer-Sheva, Israel

MICROGRAPH COMPETITION

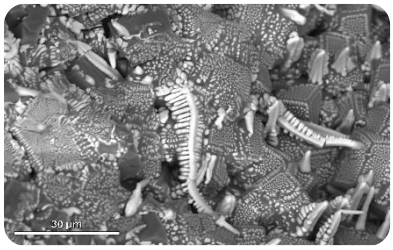
1



Phloem transfer cell – a microcosmos of organelles
Ilana Shtein and Vered Holdengreber
Ariel University

TEM image of a phloem transfer cell of Ifloga spicata, a small sand-trapping plant native to Israel. Phloem transfer cells are highly specialized parenchyma cells designed for intensive short-distance transport of sugars into or out of sieve elements of the phloem. They are distinguished by extensive cell wall ingrowths, which greatly increase membrane surface area to support high rates of transmembrane transport.

2

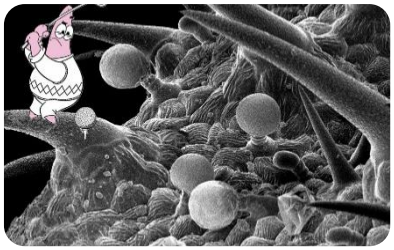


METALLURGICAL CENTIPEDE

Tamara Brider, Avishai Londner, Ilana Shtein
Tel Aviv University

Scanning electron microscope micrograph of a fracture surface of a solidified bulk obtained by induction melting of Fe, V, and Al in a ceramic crucible. The image was acquired using backscattered electrons signal.

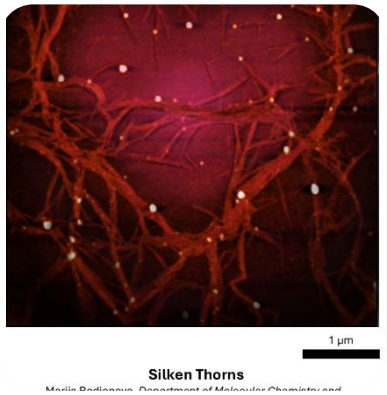
3



Golf on Sage Leaf
Olga Krichevsky
Ariel University

Glandular and non-glandular trichomes on a sage (Salvia) leaf.
Sage (Salvia) leaf exhibits several types of glandular trichomes that act as "bio-factories" for essential oils and metabolites and offer chemical defense against herbivores. In addition, non-glandular defensive trichomes offer mechanical protection to the leaf.
An sample dried in CPD and gold coated.
UHR MAIA 3 FE-SEM (Tescan), SE detector, Scale bar 100micrometer.

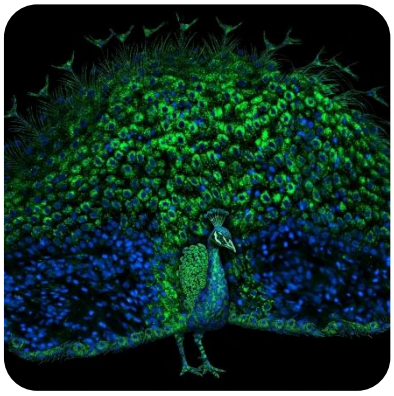
4



Silken Thorns
Mariia Rodionova
Weizmann Institute of Science

This image shows a silk nanofibrillar network. The sample was prepared from a regenerated silk solution for characterization of an experimental attempt to mimic a nanofibrillar solution of native silk fibroin, found in the final part of the gland of Bombyx mori silkworm. The image was obtained using Atomic Force Microscopy with a JPK Nanowizard 4 and processed in Gwyddion software. The sample was drop-cast onto a silica wafer, which was previously activated with oxygen plasma to improve hydrophilicity.

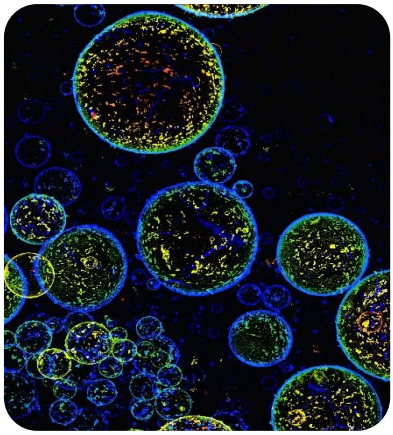
5



From Keratinocytes To Feathers
Susanna Feldma
Shamir Medical Center

This image merges immunofluorescence microscopy with a familiar display from the animal world. Human skin keratinocytes were stained for the immune checkpoint ligand OX40L (green) and counterstained with DAPI (blue), revealing a cellular architecture that immediately reminded us of a peacock's tail fan. Coincidentally, a real male peacock has been wandering around our hospital grounds for several years, delighting staff and patients and earning the name "Yossi." Inspired by this local celebrity, we photographed Yossi displaying his magnificent tail and replaced the feathers with our microscopic "peacock." The result connects similar patterns across biological scales, turning immune signaling into feathers and reminding us that scientific discovery often comes with unexpected moments of beauty—and a touch of humor—from the natural world..

6



Space-Time Foam
Alexandra Tsitrin & Yael Cohen
Ilse Kats Institute of Nanoscale Science and Technology

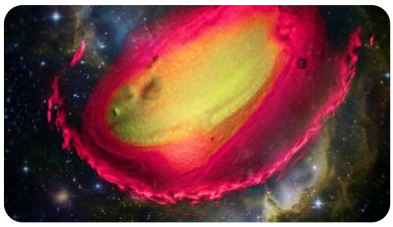
Method – superresolution microscopy (SIM2), x20 magnification
Object: synthetic peptide polimerization and formation of micro bubbles

7

Hooke's Flea, 360 Years Later (Hommage to Robert Hooke)
Alexandra Tsitrin
Ilse Kats Institute of Nanoscale Science and Technology

Method – confocal microscopy of chitin autofluorescence.
Ctenocephalides felis, the common cat flea, was first depicted in detail by Robert Hooke in his groundbreaking book Micrographia (1665). This illustration is considered one of the earliest truly scientific images of a microscopic animal in human history. It set new standards for accuracy, observation, and visual communication, helping to establish scientific illustration as a powerful tool for both research and the popularization of science. More than 360 years later, modern imaging allows us to revisit the same tiny organism and discover its intricate beauty from entirely new perspectives—bridging centuries of scientific curiosity and technological progress.

8



Cosmic Seed
Etty Grad
Bar Ilan University

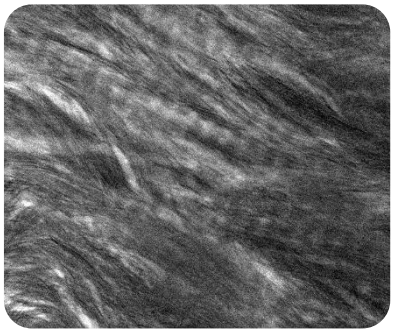
Delivery of Exogenous GFP (DNA) to Arabidopsis thaliana wild type seed via Hydrogel nano-particles.
Vladislav Rapaport, Gad Miller's lab.
Please include in the legend that the scale bar represents 50 µm and that the image was taken using a 20× objective.

9

Don't Worry Be Happy!
Irit Shoval
Bar Ilan University

Fom-1 promoter:GUS constructs was introduced into Agrobacteriumtumefaciens and stable transgenic Nicotiana tabacum plants were generated. Tissue cross sections of leaf petiole were stained for GUS activity and observed under the Leica M205 Streoscope.
Dr. Amalia Bar-Ziv from Prof. Rafael Perl-Treves lab
The image is ok. I just need to update the legend. scale bar=500um.

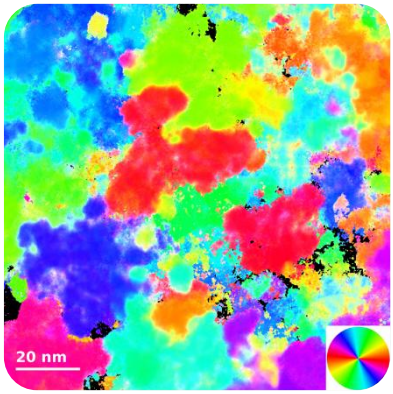
10



A Bone to Pick
Avital Wagner
Radboud University Medical Center

Bright-field scanning transmission electron microscopy (STEM) image of a thin bone lamella prepared using a focused ion beam/scanning electron microscope (FIB/SEM). In the image the two main components of bone are visible: a scaffold of collagen fibrils with their characteristic 67 nm banding pattern and intrafibrillar 4 nm-wide calcium phosphate mineral platelets.

11



NANOCRYSTALLINE CLOUDS AT THE END OF THE RAINBOW
Anastasiya Reveguk
Tel Aviv University

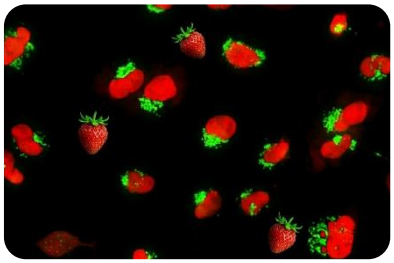
A fragment of dark-field TEM orientation map of a nanocrystalline Fe3Si thin film. The coloring is based on angular positions of the {110} and {211} reflections (color wheel in the insert).

12

Plankton Party
Irit Shoval
Bar Ilan University

iatoms produce about 1/5 of the oxygen we breath. Different growing conditions (resource limitation, viral predation) of Chaetoceros tenuissimus, a single-cell diatom species, results in different morphologies. Autofluoresecnce chlorophil (red) and Diatome silica wall was stained with PDMPO (green). Images were acquired on Leica Stellaris 5 confocal microscope using the 63x oil objective. Scale bar = 10um.

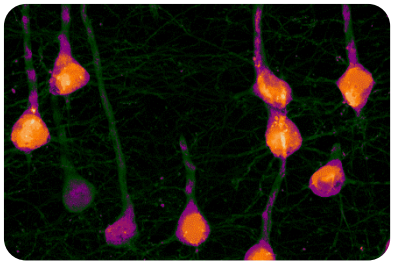
13



Strawberry Fields Forever
Irit Shoval
Bar Ilan University

This image shows kidney cells expressing different mutations in the renin protein, a key regulator of blood pressure and kidney physiology. To highlight cellular architecture, the Golgi apparatus was labelled with GFP, while the nucleus was labelled with mScarlet. The cells were imaged live using a confocal spinning disk microscope (Opera Phenix Plus High Content Screening System) with a 40× water-immersion objective. The fluorescent labelling reveals clusters of Golgi structures surrounding brightly marked nuclei, creating a pattern reminiscent of a field of strawberries. Scale bar: 25 µm.

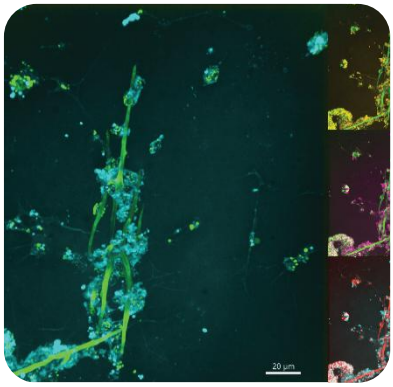
14



Neuronal Pop Art
Pratibha Ahirwal
Technion – Israel Institute of Technology

Corticospinal neurons in the mouse motor cortex labeled via retro-AAV tdTomato injection into the spinal cord (C6–C8). The image was acquired using spinning-disk confocal microscopy with a 60× objective, 560 nm laser excitation at 20% power, and 200ms exposure. It is presented as a maximum intensity projection with uniform contrast adjustment.
The scale is 20um=94px in the image

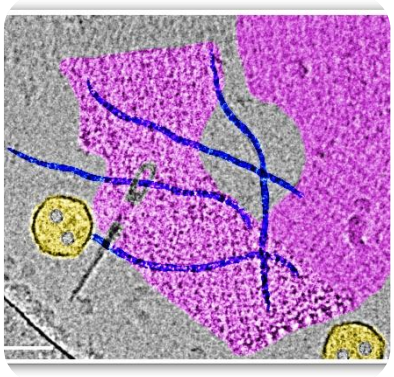
15



A Living Scaffold: Vesicles Weaving the Skeleton
Prashant Tewari
University of Haifa

A bright, sea urchin spicule runs through the center, while small glowing vesicles in skeletogenic cells move around it. These vesicles are moving in the cells along the structure and especially near the tip, where growth is happening. The image shows how skeletogenic cells come together to build a larger, stable structure.
Sample: Sea urchin skeletogenic cell culture with spicule.
Microscopy: Spinning Disc Confocal Microscope.

16

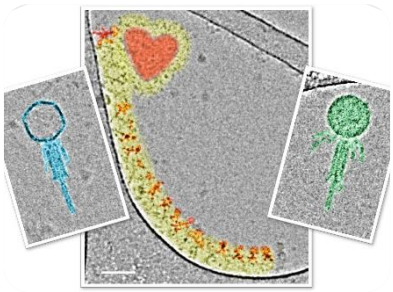


NANO-FABRIC OF LIFE

Ellina Kesselman
Technion – Israel Institute of Technology

: This cryo-TEM image shows bacteriophages released from bacterial isolates after treatment with mitomycin C, which was used to trigger prophages inside the bacteria. The scale bar is 50 nm. The sample was filtered, concentrated, and vitrificated to preserve the natural structure of the viruses. The image was taken by Dr. Ellina Kesselman, Technion Center for Electron Microscopy of Soft Matter, The Wolfson Department of Chemical Engineering, Technion. The research was performed by Vibhaw Shrivastava, PhD Candidate, guided by Prof. Naama Lang-Yona, in the Atmospheric & Environmental Microbiology Lab of the Civil & Environmental Engineering Faculty, Technion.

17

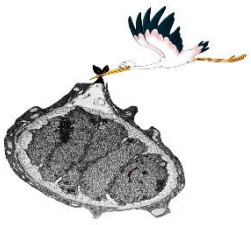


NANO-WORLD PARTY

Ellina Kesselman
Technion – Israel Institute of Technology

These cryo-TEM images show bacteriophages released from bacterial isolates after treatment with mitomycin C, which was used to trigger prophages inside the bacteria. The scale bar is 50 nm. The samples were filtered, concentrated, and vitrificated to preserve the natural structure of the viruses. The images were taken by Dr. Ellina Kesselman, The Technion Center for Electron Microscopy of Soft Matter, The Wolfson Department of Chemical Engineering, Technion. The research was performed by Vibhaw Shrivastava, PhD Candidate, guided by Prof. Naama Lang-Yona in the Atmospheric & Environmental Microbiology Lab of the Civil & Environmental Engineering Faculty, Technion.

18



A speedy delivery at 11,000x

Shivani Pundir
Technion – Israel Institute of Technology

Five cap cells unwrapped within a shared ECM from Drosophila Melanogater's lateral pentascolopidial organ.

PLENARY LECTURE I (Thursday, May 14, 2026, 09:50)

MULTI-DIMENSIONAL VIEWS OF CELL-MICROENVIRONMENT INTERACTIONS: A 5-DECADE JOURNEY

Benny Geiger
Department of Immunology and Regenerative Biology, Weizmann Institute of Science, Rehovot, Israel

An accidental discovery of vinculin some 50 years ago, opened a new chapter in our understanding of the molecular mechanisms underlying the adhesive interactions of cells with their neighbors, and with the extracellular microenvironment. Starting with vinculin, as a key component of integrin-mediated adhesions, this initial discovery led to a highly multidisciplinary research, in which cutting-edge microscopy was integrated with biological physics, nanotechnology, synthetic biology, computational structural biology, cancer biology and, recently, cancer immunotherapy. Some milestones along this journey will include:

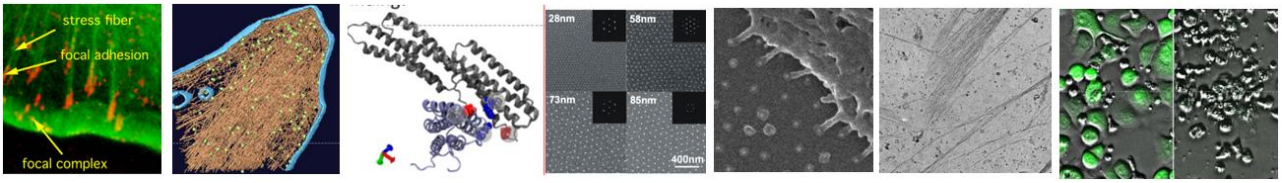
· Correlative light microscopy-cryo-electron tomography-based molecular mapping on adhesion complexes (Medalia)

· Molecular complexity of adhesion sites – the integrin adhesome structure and function (Zamir, Zaidel-Bar)

· Use of advanced nanotechnologies for probing basic mechanisms in environmental cellular interactions (Spatz)

· Vinculin as mechanosensitive regulator of integrin adhesions – from computational protein design to modulation of adhesion sites (Bershadsky, Wolfenson, Gräter)

· Synthetic immune niche – for enhancement of cancer immunotherapy (Friedman)



PLENARY LECTURE II (Thursday, May 14, 2026, 11:20)

ELUCIDATING STRUCTURE–FUNCTION RELATIONSHIPS IN BIOLOGICAL AND BIO-INSPIRED MATERIALS

Boaz Pokroy
Department of Materials Engineering, Technion - Israel Institute of Technology, Haifa, Israel

Biomineralization processes enable organisms to produce a wide variety of functional materials exhibiting remarkable mechanical, optical, magnetic, and other properties. Unlike synthetic approaches, biological systems achieve precise control over polymorph selection, crystal morphology, hierarchical organization, and even atomic-scale structure and ambient conditions. As a result, natural materials often display extraordinary and highly specialized functionalities, despite being composed of relatively simple constituents that differ from those typically selected in engineering design.

In this talk, I will present selected examples of mineralized biological tissues, highlighting how advanced characterization techniques are employed to elucidate their underlying structure–function relationships. These include insights gained through complementary high-resolution and in situ methods. In addition, I will showcase bio-inspired material systems that emulate key strategies utilized by living organisms in crystal formation, demonstrating how these principles can be translated into the design of novel functional materials.

PARALLEL SESSIONS I: Life Sciences (Thursday, May 14, 2026, 14:00)

3D LABEL-FREE IMAGING OF RAPID BIOLOGICAL CELL DYNAMICS VIA INTERFEROMETRIC MULTIPLEXING

Natan T. Shaked
School of Biomedical Engineering, Tel Aviv University, Tel Aviv, Israel

Label-free optical microscopy employs nondestructive approaches to visualize biomedical samples. It utilizes endogenous intrinsic signals rather than specific exogenous markers or genetic modifications, which may perturb the natural biological processes, dynamics, and responses of live cells. A major challenge in optical microscopy of live cells is achieving affordable, label-free, three-dimensional (3D), and fully quantitative measurements that provide high-resolution morphological and content-based mapping of dynamic cell populations at the single-cell level. The extent of spatial and quantitative molecular information that can be extracted by label-free techniques, encompassing not only structural but also content-based data, represents a significant advantage over conventional imaging methods. Off-axis interferometric multiplexing enables the simultaneous capture of several complex wavefronts, each encoded with a distinct interference fringe orientation, using a single camera exposure. This capability gives rise to numerous applications, particularly for imaging dynamic biomedical samples. These include field-of-view multiplexing, depth-of-field multiplexing, angular perspective multiplexing for tomographic phase microscopy in 3D refractive index imaging, multi-wavelength multiplexing for phase unwrapping or spectroscopy, super-resolution interferometric imaging with a synthetic aperture, imaging of ultrafast events, measurement of the Jones matrix and sample birefringence, and the simultaneous acquisition of multiple fluorescence microscopy channels alongside quantitative phase profiles. Each of these techniques opens new opportunities for applying wide-field interferometry to efficiently measure complex biological dynamics. One application that can particularly benefit from interferometric multiplexing is label-free imaging flow cytometry, which holds significant potential for medical diagnosis due to its ability to analyze large numbers of biological cells in flow from samples obtained from body fluids. I will present our recent results in 3D label-free interferometric imaging flow cytometry for liquid biopsies, featuring real-time cell analysis and sorting capabilities for cancer monitoring, blood analysis, and sperm selection for in vitro fertilization.

PARALLEL SESSIONS I: Life Sciences (Thursday, May 14, 2026, 14:00)

Mutsafi: NUCLEAR SPECKLES ARE REGULTORY HUBS FOR VIRAL AND HOST MRNA EXPRESSION DURING HSV-1 INFECTION

Shani Nadav Eliyahu[1], Chaya Bohrer[1], Alon Boocholez[1], Noa Kinor[1], Vesa Aho[2], Jennifer I.C. Benichou[1], Salla Mattola[2], Sami Salminen[2], Henri Niskanen[3], Minna U Kaikkonen[3], Maija Vihinen-Ranta[2], Yaron Shav-Tal[1]

[1]*The Mina & Everard Goodman Faculty of Life Sciences & Institute of Nanotechnology, Bar-Ilan University, Ramat Gan, Israel*

[2]*Department of Biological and Environmental Science and Nanoscience Center,, University of Jyvaskyla, Jyvaskyla, Finland*

[3]*A.I. Virtanen Institute for Molecular Sciences, University of Eastern, Kuopio, Finland*

This work was recently published in PNAS, and all data can be found here: https://doi.org/10.1073/pnas.2511555123

Herpes simplex virus type 1 (HSV-1) infection remodels the host nucleus, marginalizing chromatin and forming viral replication compartments (VRCs). Nuclear speckles, nuclear bodies enriched in RNA-processing factors, reposition around VRCs and undergo structural changes (Movie 1). While viral mRNAs are transcribed in VRCs and host transcription is largely suppressed, the nuclear routes used by viral and upregulated host transcripts and their relationship with nuclear bodies, remain unclear. We show that immediate-early (IE) viral transcripts (RL2) uniquely accumulate in nuclear speckles (Figure 1), unlike early or late transcripts (UL30), revealing a selective nuclear speckle-dependent pathway. Similarly, host mRNAs upregulated during infection traffic into nuclear speckles after transcription (Movie 2). Moreover, nuclear speckles are structurally remodeled, marked by lncRNA MALAT1 removal and increased dynamics of the nuclear speckle core protein SRRM2 (Figure 2). Lastly, we found that blocking mRNA export causes IE transcripts to accumulate in nuclear speckles, and that nuclear speckle disassembly severely impairs IE mRNA export, preventing downstream viral gene expression. These findings establish nuclear speckles as dynamic regulatory hubs that selectively facilitate the processing and export of IE viral mRNAs during HSV-1 infection.

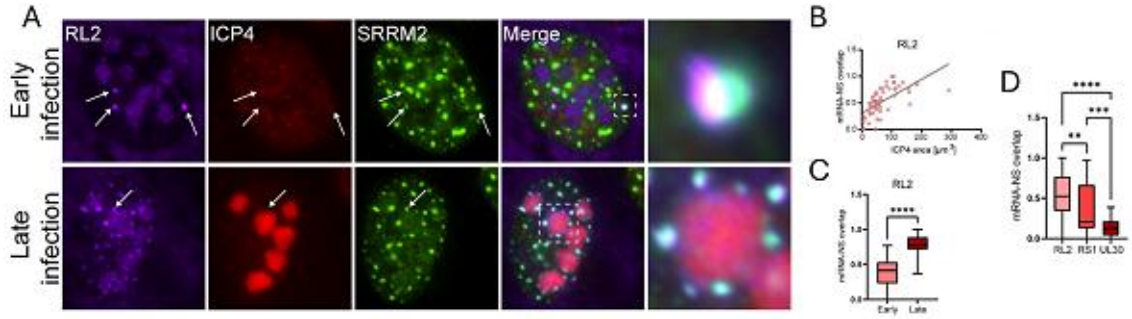


Figure 1: Viral mRNAs are transcribed near nuclear speckles and IE RL2 and RS1 viral mRNA accumulate within. (A) U2OS cells were infected for 6 hrs (MOI=5) and labeled with fluorescent probes for the viral mRNAs RL2/RS1/UL30 (purple) (presented here only RL2). ICP4 protein marks the VRCs (red), and SRRM2 marks nuclear speckles (green). Enlarged images show cells at an early infection stage where viral mRNAs are found near nuclear speckles and at a late infection stage where IE viral mRNAs are found localized within nuclear speckles (infection stage determined by VRC

volume-ICP4 area). Scale bars= 10 µm. (B) Plots depicting the overlap of nuclear speckles (NS) with viral mRNA RL2 (n=59). (C) Nuclear speckles overlap with RL2 viral mRNA plots are divided to early and late infection stages. Nuclear speckles overlap with RL2 is statistically different between early and late infection ($P < 0.0001$). (I) Nuclear speckles overlap with all three viral mRNAs and show a statistical difference between all 3 transcripts: RL2-RS1 $P = 0.0046$, RL2-UL30 $P < 0.0001$, RS1-UL30 $P = 0.0004$.

Movie 1. Link to the movie. Time-lapse movie of U2OS cells infected for 6 hrs with HSV-1 ICP4-EYFP (yellow), and imaged every 10 minutes. The endogenous SRRM2 protein was fused to a mScarlet fluorescent protein (red). Scale bar = 10 µm.

Movie 2. Link to the movie. Time-lapse movie of U2OS cells infected for 3 hrs, and imaged every 400 msec. Endogenous NPM1 mRNA was tagged using A1-Halo-MCP (purple), and the endogenous SRRM2 protein was fused to a mScarlet fluorescent protein (green). A white square was drawn around the NPM1 active site of transcription and adjacent nuclear speckles, where nascent transcripts are observed moving from the gene and diffusing to the close nuclear speckles. Scale bars= 10 µm.

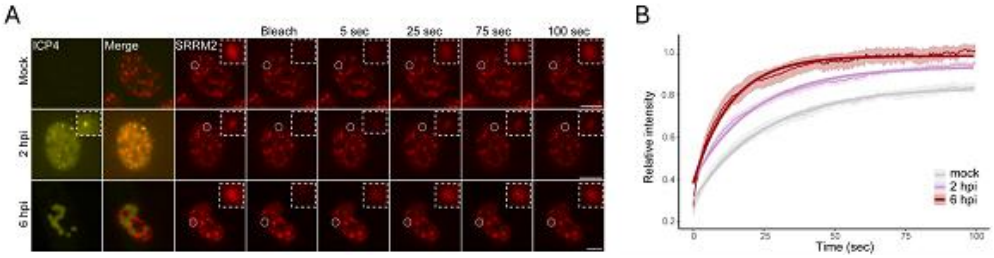


Figure 2: HSV-1 infection induces changes in nuclear speckle dynamics. (A) A FRAP experiment on U2OS cells, in which endogenous SRRM2 is fused to mScarlet (red), at: mock infected, 2 hpi and 6 hpi (MOI=5) with HSV-1 ICP4-EYFP (yellow). Scale bar= 10 µm. (B) Plot of FRAP results showing the rate of fluorescence recovery, rate is significantly different between mock and 6 hpi, and 2 hpi and 6 hpi ($P = 0.0206$, 0.0248 respectively). The plateau is significantly different between mock and 2 hpi, and mock and 6 hpi ($P = 0.0372$, 0.0112 respectively). Mock n=32, 2 hpi n=39, 6hpi n= 35, in 4 biological replicates.

PARALLEL SESSIONS I: Life Sciences (Thursday, May 14, 2026, 14:00)

FROM BLACK TO WHITE: *DE NOVO* BIOGENESIS OF A LIGHT-SCATTERING ORGANELLE DURING PIGMENT CELL TRANSDIFFERENTIATION

Yael Noy[1], Yuval Barzilay[1], Neta Varsano[2], Tali Shalit[3], Zohar Eyal[1], Sourabh Bera[1], Tali Lerer-Goldshtein[1], Andrea Sorrentino[4], Katya Rechav[2], Meital Kupervaser[3], Lothar Houben[2], Uwe Heinig[5], Iddo Pinkas[2], Ziv Porat[5], Dvir Gur[1]

[1]*Department of Molecular Genetics, Weizmann Institute of Science, Rehovot, Israel*

[2]*Department of Chemical Research Support, Weizmann Institute of Science, Rehovot, Israel*

[3]*The De Botton Protein Profiling Institute of the Nancy and Stephen Grand Israel National Center for Personalized Medicine, Weizmann Institute of Science, Rehovot, Israel*

[4]*Mistral Beamline, ALBA Synchrotron Light Source, Cerdanyola del Vallès, Spain*

[5]*Department of Life Science Core Facilities, Weizmann Institute of Science, Rehovot, Israel*

Pigment cells are ubiquitous in nature and are responsible for the diverse coloration of our world, serving essential roles in camouflage, signalling, thermoregulation, and photoprotection[1]. In zebrafish (Danio rerio), coloration is primarily driven by three pigment cells (chromatophores): melanophores, xanthophores, and iridophores[2,3], which belong to the broader family of lysosome-related organelles (LROs)[4]. Each type of chromatophore produces a specific biomolecule (pigment) that contributes to its distinctive coloration. Recently, a novel cell type, the melanoleucophore (ML), was identified at the distal edge of the dorsal fin[5]. These cells undergo a remarkable transformation, transitioning from black, light-absorbing melanophores to white, light-scattering MLs[6]. This phenotypic switch requires a drastic shift in cellular metabolism, from melanin synthesis to guanine production, yet the underlying molecular mechanisms of this transdifferentiation remain largely unknown. In this study, I employed an integrative approach, combining novel correlative cryo-electron microscopy, synchrotron cryo-soft X-ray microscopy, and X-ray absorption spectroscopy, together with quantitative proteomics and *in situ* mass spectrometry imaging to map this transformation. I show that this transdifferentiation is driven by three coordinated processes: **i.** *De novo* organelle biogenesis: The assembly of a specialized, guanine-crystal-forming, lysosome-related organelle. **ii.** Metabolic rewiring: During transdifferentiation, the cells undergo a metabolic shift that redirects purine flux toward guanine biosynthesis, driving the production of reflecting material while suppressing melanin synthesis. **iii.** Ultrastructural remodelling: I identify a scaffold-based crystal nucleation mechanism that employs disordered fibrous templates to tune crystal architecture for broadband light scattering. My findings characterize a rare instance of direct cellular transdifferentiation involving the complete replacement of a cell`s primary organelle and metabolic identity, enabled by an integrated correlative workflow that links advanced imaging with molecular profiling. This research provides a new model for studying cellular plasticity, organelle biogenesis, and the bioengineering of complex optical properties.

References:

1. Hashimoto, H., Goda, M., Futahashi, R., Kelsh, R. N. & Akiyama, T. Pigments, Pigment Cells and Pigment Patterns (Springer, Singapore, 2021).
2. Raposo, G. & Marks, M. S. Melanosomes—dark organelles enlighten endosomal membrane transport. Nat. Rev. Mol. Cell Biol. 8, 786–797 (2007).
3. Gur, D., Palmer, B. A., Weiner, S. & Addadi, L. Light manipulation by guanine crystals in organisms: biogenic scatterers, mirrors, multilayer reflectors and photonic crystals. Adv. Funct. Mater. 27, 1603514 (2017).
4. Marks, M. S., Heijnen, H. F. G. & Raposo, G. Lysosome-related organelles: unusual compartments become mainstream. Curr. Opin. Cell Biol. 25, 495–505 (2013).
5. Lewis, V. M. et al. Fate plasticity and reprogramming in genetically distinct populations of Danio leucophores. Proc. Natl Acad. Sci. USA 116, 11806–11811 (2019).
6. Huang, D. et al. Agouti and BMP signaling drive a naturally occurring fate conversion of melanophores to leucophores in zebrafish. Proc. Natl Acad. Sci. USA 122, e2424180122 (2025).

PARALLEL SESSIONS I: Life Sciences (Thursday, May 14, 2026, 14:00)

AN ENGINEERED PLATFORM TO STUDY THE INFLUENCE OF EXTRACELLULAR MATRIX NANOTOPOGRAPHY ON CELL ULTRASTRUCTURE

Shani Tcherner Elad[1], Rita Vilensky[1], Noa Ben Asher[1], Nataliya Logvina[1], Ran Zalk[2], Eyal Zussman[1], Leeya Engel[1,3]

[1]*Faculty of Mechanical Engineering, Technion– Israel Institute of Technology, Haifa, Israel*

[2]*lse Katz Institute for Nanoscale Science and Technology, Ben-Gurion University of the Negev, Beer Sheva, Israel*

[3]*The Resnick Sustainability Center for Catalysis, Technion– Israel Institute of Technology, Haifa, Israel*

Nanoscale fabrication techniques have played an essential role in revealing the impact of extracellular matrix (ECM) nanotopography on cellular behavior. However, the mechanisms by which nanotopographical cues from the ECM influence cellular function remain unclear. To approach these questions, we have engineered a novel class of nanopatterned ECM constructs suitable for cryogenic electron tomography (cryo-ET), the highest resolution modality for imaging frozen hydrated cells in 3D. We electrospun aligned and randomly oriented ECM fibers directly onto transmission electron microscopy (TEM) supports to generate fibrous scaffolds that mimic physiological ECM in healthy (organized ECM) and diseased (disorganized ECM) states. We produced fibers from gelatin without toxic additives and cross-linked them to maintain structural stability in aqueous environments. The electrospun fibers had an average fiber diameter of hundreds of nanometers. We confirmed that the nanopatterned TEM supports can serve as viable cell culture substrates that can influence cell organization and demonstrated their compatibility with plunge freezing and cryo-ET. By enabling nanoscale structural analysis inside cells on substrates with programmable topographies, this platform can be used to study the physical cues necessary for healthy endothelial tissue formation and pathologies that are linked to endothelial dysfunction in diseases such as peripheral arterial disease.

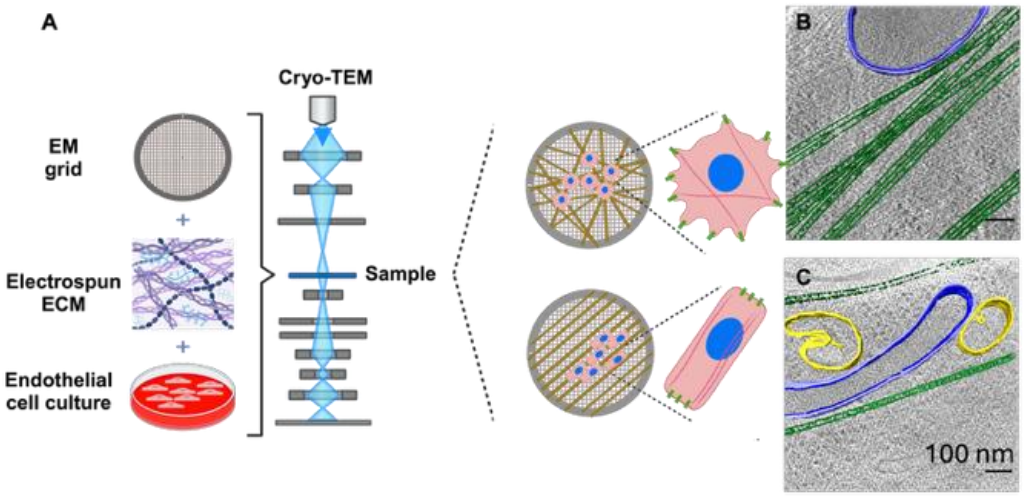


Fig. 1: Graphical abstract. (A) Schematic depicts a platform for high resolution cryo-TEM imaging of cells grown on ECM with different topographical cues. (B-C) Tomographic slices overlaid with segmentation of select features in (B) showing a double-membranes organelle (membranes in blue and violet), microtubules (green), and vesicles (yellow), and in (C) showing a double-membranes organelle (membranes in blue and violet) and microtubules (green).

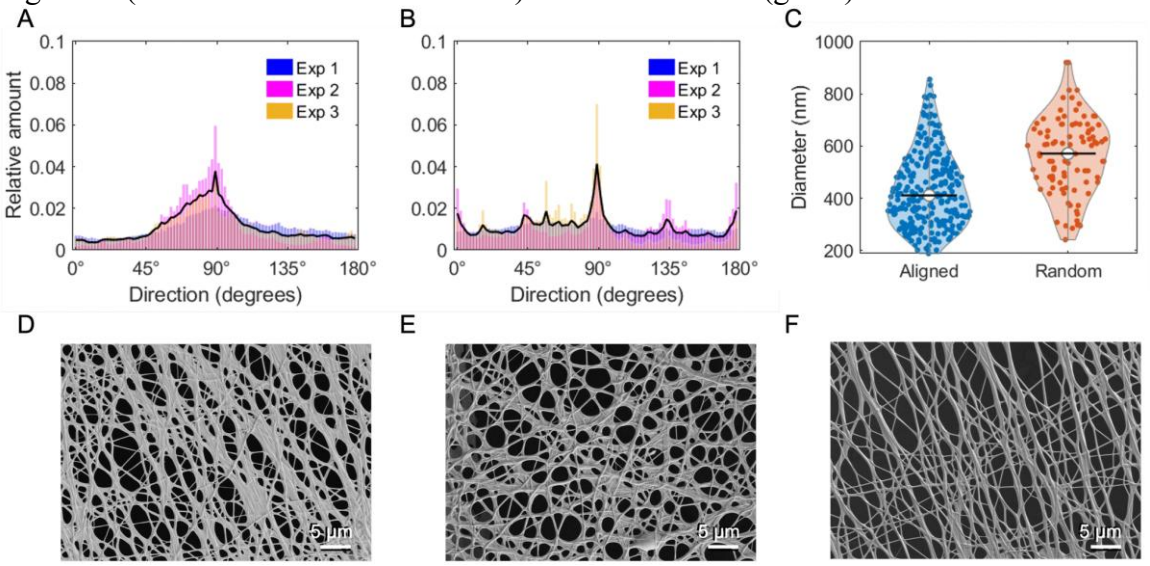


Fig. 2: Fiber characterization. (A and B) Histograms of preferred fiber orientation for three separate experiments for aligned (A) and random (B) fiber orientations; black line represents a weighted average. (C) Violin plot depicts fiber diameter for random (red) and aligned (blue) oriented fibers; black line indicates the median. (D–F) HRSEM images of gelatin fibers electrospun directly onto gold TEM grids. (D) Aligned fibers. (E) Randomly oriented fibers. (F) Aligned oriented fibers after 4 months of storage in a desiccator.

PARALLEL SESSIONS I: Life Sciences (Thursday, May 14, 2026, 14:00)

QUANTIFYING ION TRANSPORT AND ELECTROCHEMICAL GRADIENTS IN SYNTHETIC CELL MEMBRANES

Ran Tivony[1]
Chemical Engineering, Ben-Gurion University of the Negev, Beer-Sheva, Israel

Living cells generate and store energy through controlled ion transport across their membranes, creating electrochemical gradients that drive ATP synthesis, nutrient uptake, and membrane potential maintenance. Reproducing these fundamental functions in synthetic membrane systems such as giant unilamellar vesicles (GUVs), micron-sized liposomes, is an important goal toward achieving artificial cells with life-like functionalities. However, achieving this objective remains challenging due to the lack of quantitative, single-compartment methods to measure ion fluxes and electrochemical gradient formation in such synthetic cell-like systems. Here, we present a fluorescence-based approach for quantifying ion fluxes and the resulting changes in electrochemical potential gradients across the membranes of individual GUVs. To achieve precise control over vesicle size and membrane composition, we developed an integrated microfluidic platform enabling high-throughput production and purification of monodisperse GUVs. By combining this platform with quantitative fluorescence analysis, we determined the permeation rates of two biologically important ions – protons (H^+) and potassium (K^+) – and directly correlated their fluxes with electrochemical gradient accumulation across the lipid bilayer of single vesicles. Using the same analytical framework, we quantified the ion selectivity of two archetypal ion channels, gramicidin A and outer membrane porin F (OmpF), by measuring the permeation rates of H^+ and K^+. We found that proton translocation through gramicidin A is four orders of magnitude faster than potassium transport, whereas OmpF exhibits comparable permeation rates for both ions. Together, these results provide a quantitative framework to guide the design of GUV-based synthetic cells with increasingly complex transport functions and to systematically probe ion transport mechanisms central to living systems.

PARALLEL SESSIONS I: Life Sciences (Thursday, May 14, 2026, 14:00)

LOW-DOSE LIQUID-PHASE ELECTRON MICROSCOPY OF BONE MINERALIZATION

Avital Wagner[1], Luco Rutten[1,2], Rona Roverts[1,2], Anat Akiva[2], Nico Sommerdijk[1,2]
[1]*Medical BioSciences, Radboud University Medical Center, Nijmegen, Netherlands*
[2]*Electron Microscopy Center, Radboudumc Technology Center Microscopy, Nijmegen, Netherlands*

Biomineralization is the process organisms use to make their hard mineralized tissues from inorganic ions. In humans, there are both physiological (e.g., bone and teeth) and pathological (e.g., heart valve calcifications and kidney stones) mineral formation processes, commonly occurring on pre-existing organic scaffolds. While much is known about the collagen scaffold and CaP minerals themselves, the earliest nucleation and growth events remain difficult to observe because most in situ imaging modalities lack the required spatial resolution. Liquid-phase electron microscopy (LP-EM) is an established method for capturing dynamic processes at nanometer resolution.[1] However, applications in the life sciences remain limited,[2,3] largely because organic materials are particularly prone to electron beam damage and have low contrast. Our goal is to develop LP-EM for the investigation of biomineralization in tissues.

Here, we used FIB/SEM to make and place a thin bone lamellae on the electron transparent window of a LP-EM chip. We then optimized scanning transmission electron microscopy (STEM) imaging parameters to reduce the dose below 3 e^-/A^2 per image.[4] This is enabled in part by sub-sampling during image acquisition and inpainting algorithms to reconstruct the full image.[5] The reconstructed images had sufficient resolution to distinguish between individual mineral plates (4 nm thick) in dry samples. Next, we flow de-mineralizing and re-mineralizing solutions into the liquid chip and record images as the processes occurs. We demonstrate this low-dose LP-EM workflow is effective for imaging beam-sensitive materials and biological processes.

1. J.J. De Yoreo, N.A.J.M. Sommerdijk.X. Nature Reviews Materials 1, 16035 (2016).

2. D.B. Peckys, E. Macías-Sánchez, & N. de Jonge, MRS Bulletin 45, 754–760 (2020).

3. L. Rutten, et al. Adv. Funct. Mater. 35, 11, 2416938 (2025)

4. N. De Jonge, Ultramicroscopy 187, 113–125 (2018).

5. D. Nicholls, J. Wells, A. Stevens, Y. Zheng, J. Castagna, N.D. Browning, Ultramicroscopy, 233, 113451 (2022).

PARALLEL SESSIONS I: Life Sciences (Thursday, May 14, 2026, 14:00)

BOOST AND BRAKE: ONE SWITCH THAT TUNES PHOTOSYNTHESIS

Dvir Harris[1,2], Hila Toporik[3,4], Mohamed Elrefay[5], Christopher Gisriel[6], Doran Raccah[5], Yuval Mazor[3], Gabriela S. Schlau-Cohen[2]
[1]*Chemistry, Technion - Israel Institute of Technology, Haifa, Israel*
[2]*Chemistry, Massachusetts Institute of Technology, Cambridge, MA, USA*
[3]*Biodesign Institute, School of Molecular Sciences, Arizona State University, Tempe, AZ, USA*
[4]*Robert H. Smith Institute of Plant Sciences and Genetics in Agriculture, Faculty of Agriculture, Hebrew University of Jerusalem, Rehovot, Israel*
[5]*Chemistry, The University of Texas at Austin, Austin, TX, USA*
[6]*Biochemistry, University of Wisconsin-Madison, Madison, WI, USA*

Photosynthetic organisms harvest solar energy with near-unity quantum efficiency using pigment-protein supercomplexes embedded in flexible membranes in cyanobacterial membranes. Under iron limitation, cyanobacteria express the iron-starvation induced protein A (IsiA), which hich has been suggested to function as an antenna, quencher, and/or chlorophyll reservoir. How these possible, contradicting
functions arise from a common monomeric building block, and how efficient energy transfer persists despite structural variability, has remained unclear. Here, we combine purification of monomeric IsiA, ensemble and single-molecule fluorescence spectroscopy, cryo-EM, and structure-based simulations to connect IsiA photophysics to the 2-MDa PSI-IsiA supercomplex. In monomeric IsiA, we identify photophysical subpopulations, including a quenched, red-shifted state assigned to a single chlorophyll site at the IsiA-IsiA and IsiA-PSI interfaces, indicating that the monomer encodes functional multiplicity. Cryo-EM of PSI-IsiA reveals pronounced structural heterogeneity, with large variations in IsiA position relative to PSI. Yet
single-molecule measurements and simulations show rapid IsiA-to-PSI energy transfer across all conformations, with up to three-fold enhancement in rare states.
Together, these results show how intrinsic IsiA properties and assembly-level plasticity enable versatile function and robust energy transfer during iron-stress acclimation.

PARALLEL SESSIONS I: Materials Science (Thursday, May 14, 2026, 14:00)

FROM IMAGING TO DECODING: DATA-DRIVEN ELECTRON MICROSCOPY FOR DISORDERED MATERIAL SYSTEMS

Yevgeny Rakita[1], Mridul Kumar[1]
Materials Engineering, Ben Gurion University of the Negev, Beer Sheva, Israel

Microscopy is increasingly expected not only to image materials, but also to resolve how they evolve across space, time, and metastable states. In my group, we focus on disordered and far-from-equilibrium materials, where functionality is often governed by nanoscale chemical and structural heterogeneity between metastable states, nanodomain morphology, and their evolution. These include multi-component, glass-forming regenerative material systems, such as phase-change materials, sol-gel oxides, metallic glasses, Relaxors, MXenens, and others. In all these examples, structure–property relations cannot be fully understood through ensemble-averaged measurements alone.

In this talk, I will present our recent efforts to extend electron microscopy into a quantitative, data-driven platform for probing structural evolution in complex materials. A central part of this approach is Scanning Nano-structure Electron Microscopy (SNEM), a framework built on 4D-STEM, together with simultaneously acquired analytical signals, such as EDS and EELS, which are correlated in space and jointly analyzed to extract local structural and chemical information from highly heterogeneous systems. By combining real-space mapping, diffraction-based signatures, spectroscopic contrast, and machine-learning-assisted clustering, we aim to identify hidden structural domains, follow their evolution, and connect them to emergent materials functionality.

I will highlight examples showing how microscopy can reveal nanoscale order in nominally amorphous systems, map transformations within amorphous domains and their interfaces with crystalline regions, map nano-scale density fluctuations, and follow nucliation events. More broadly, I will discuss how integrating advanced electron microscopy with data science opens new opportunities to study materials as evolving systems and overcome common challenges. This perspective is particularly powerful for next-generation functional materials, where understanding local disorder, transient states, and structural pathways is essential for their rational design.

1. Y. Rakita. et al., "Mapping structural heterogeneity at the nanoscale with scanning nano-structure electron microscopy (SNEM)." Acta Materialia. 242 (2023) 118426.

2. M. Kumar et al. “Prediction of EDS Maps from 4DSTEM Diffraction Patterns Using Convolutional Neural Networks”; ArXiv, (2025), https://doi.org/10.48550/arXiv.2508.20657

3. M. Kumar et al. “Protocol for Clustering 4DSTEM Data for Phase Differentiation in Glasses”; ArXiv, (2025), https://doi.org/10.48550/arXiv.2509.00943

PARALLEL SESSIONS I: Materials Science (Thursday, May 14, 2026, 14:00)

PROBING SUPERFLUORESCENT EMISSION IN PEROVSKITE QUANTUM DOTS THROUGH ULTRAFAST CATHODOLUMINESCENCE ELECTRON MICROSCOPY

Shai Levy[1], Yehonadav Bekenstein[1]
Materials Science and Engineering, Technion Israel Institute of Technology, Haifa, Israel

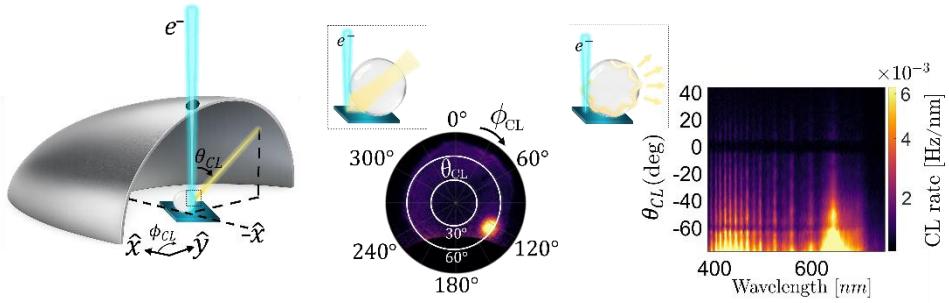
Understanding long-range coherence and emerging correlations in solid-state systems is pivotal for developing future quantum materials and devices. Under suitable conditions, closely packed quantum dots (QDs) can support collective coherent interactions, which may result in superfluorescent light emission. Despite major efforts, directly resolving these correlations at the nanometer scale where they originate has remained an open challenge. Here, we use ultrafast cathodoluminescence scanning electron microscopy to probe the local emission and induce free-electron-driven superfluorescence in lead halide perovskite QD assemblies. Ultrafast electron microscopy at cryogenic temperatures enables us to excite and observe correlations between QDs at nanometric scales and to study emission dynamics with picosecond temporal resolution. By adjusting the electron probe, we transition the system between uncoupled spontaneous emission, to correlated superfluorescent emission regimes. As the coupled QDs are highly sensitive to structural and spectral inhomogeneities within the assembly, we use hyperspectral emission mapping to examine the effects of defects of the QD assembly on their emission. Advanced time-resolved spectroscopy and interferometric analysis of the light emitted by the QDs present the key temporal and spectral features of this collective emission process. These findings establish cathodoluminescence superfluorescence as a platform for investigating quantum correlations in solids, highlighting ultrafast electron microscopy as a powerful approach for high-resolution characterization of emerging coherent optical phenomena in quantum materials

PARALLEL SESSIONS I: Materials Science (Thursday, May 14, 202, 14:00)

CATHODOLUMINESCENCE ENHANCEMENT MECHANISMS IN SILICA MICROSPHERES

Hadar Aharon[1], Ofer Kfir[1], Zahava Barkay[2], Sophie Meuret[3]
[1]*School of Electrical and Computer Engineering, Iby and Aladar Fleischman Faculty of Engineering, Tel Aviv University, Tel Aviv, Israel*
[2]*Jan Koum Center for Nanotechnology and Nanoscience, Tel Aviv University, Tel Aviv, Israel*
[3]*CEMES–CNRS, Toulouse, France*

Cathodoluminescence (CL) enables optical-frequency analysis of samples with nanometer resolutions, originating from the interaction of a focused electron beam with radiative electronic states, or directly with the optical modes of the sample. Here we decompose the various mechanisms underlying CL generation and emission from an archetype spherical resonator using its spectral, angular and spatially resolved features. We investigate radiation of optical whispering-gallery modes (WGM) in regimes of coherent and incoherent luminescence. The use of different experimental regimes allows us to disentangle the different contributions to the CL in spheres, namely, photon absorption, generation and radiative leakage, and conclude that the photon generation occurs precisely on the sphere`s surface. In addition, the spheres serve as high-NA collimating lenses for CL, resulting in mode quality unprecedented for CL in free space. We believe that such collimated and directed CL in free space will enhance existing quantum measurements of CL and facilitate new ones, such as high-rate electron-photon entangled pairs, CL from quantum emitters, and homodyne analysis of CL.



Schematic of the measurement setup. A focused electron beam generates CL, which is collected by a parabolic mirror and mapped as a function of polar and azimuthal angles, . Insets illustrate two distinct enhancement mechanisms: geometrical collimation of external CL (left), shown with a representative angular emission map, and excitation of a WGM (right), shown with a representative -resolved spectrogram.

PARALLEL SESSIONS I: Materials Science (Thursday, May 14, 2026, 14:00)

OPERANDO SCANNING ELECTRON MICROSCOPY STUDY OF NICKEL FOAM CATALYST DURING AMMONIA DECOMPOSITION REACTION

Roey Ben David[1], Luis Sandoval Diaz[2], Annika Kubsch[2], Raoul Blume[2], Frank Girgsdies[2], Zahra Gheisari[2], Wiebke Frandsen[1], See Wee Chee[1], Beatriz Roldan Cuenya[1], Thomas Lunkenbein[2]

[1]*Department of Interface Science, Fritz-Haber Institute of the Max Planck Society, Berlin, Germany*

[2]*Department of Inorganic Chemistry, Fritz-Haber Institute of the Max Planck Society, Berlin, Germany*

Capturing the changes a catalyst undergoes during gas–solid reactions is critical for understanding the structure-activity relationship of heterogeneous catalysts and identifying their active phase. Operando electron microscopy enables direct observation of the catalyst's structure and morphology under realistic reaction conditions and allows correlation between dynamic structural changes and catalytic activity [1]. In this work, we employ operando environmental scanning electron microscopy (ESEM) [2] equipped with a customized flow reactor and a mass spectrometer to investigate the morphological evolution of a Ni foam catalyst during ammonia decomposition at elevated temperatures (550-650 °C). Complementary near-ambient pressure X-ray photoelectron spectroscopy (NAP-XPS) measurements were performed to monitor changes in the surface chemistry of Ni under similar reaction conditions.

Our results demonstrate that ammonia decomposition, the reverse reaction of the Haber–Bosch process for ammonia synthesis, is not solely a surface reaction, as is often assumed [3]. The dehydrogenation of ammonia on the Ni surface produces atomic nitrogen, which dissolves into the bulk of the catalyst concurrently with N_2 desorption. The penetration and accumulation of nitrogen induce significant structural changes in the Ni catalyst, including the nucleation and growth of surface precipitates, as well as the formation of cracks and voids along grain boundaries. Nitrogen dissolution also affects the rate of N_2 formation and the apparent activation energy for N_2 evolution relative to H_2 production. Overall, our study provides direct insight into the structural evolution and surface chemistry of Ni-based catalysts during ammonia decomposition, revealing the interplay between surface and bulk processes and their impact on the catalytic activity.

References

[1] S. W. Chee, T. Lunkenbein, R. Schlögl, B. Roldán Cuenya, Chem. Rev. 2023, 123, 13374–13418.

[2] L. Sandoval-Diaz, M. Plodinec, D. Ivanov, S. Poitel, A. Hammud, H. C. Nerl, R. Schlögl, T. Lunkenbein, Journal of Energy Chemistry 2020, 50, 178–186.

[3] X. Duan, G. Qian, Y. Liu, J. Ji, X. Zhou, D. Chen, W. Yuan, Fuel Processing Technology, Elsevier B.V., 2013, pp. 112–117.

PARALLEL SESSIONS I: Materials Science (Thursday, May 14, 2026, 14:00)

CRYSTAL STRUCTURE METROLOGY USING SCANNING TRANSMISSION ELECTRON MICROSCOPY

Amram Azulay[1], Itai Silber[2], Yoram Dagan[2], Amit Kohn[1]
[1]*Department of Materials Science and Engineering, The Iby and Aladar Fleischman Faculty of Engineering, Tel Aviv University, Tel Aviv, Israel*
[2]*School of Physics and Astronomy, Raymond and Beverly Sackler Faculty of Exact Sciences, Tel Aviv University, Tel Aviv, Israel*

Scanning transmission electron microscopy (STEM) allows imaging of crystalline structures at ~ 50 pm spatial resolution, thus enabling measurements of distance between atomic columns. Furthermore, it enables to locally resolve strain in crystals [1-2] and to calibrate the detector pixel size. We present a method dedicated to the evaluation of distances between crystallographic planes (interplanar spacings, d-spacings), based on an algorithm that includes curve fitting of processed high-angle annular dark-field STEM images [3]. By testing simulated images of $SrTiO_3$, we confirm that our proposed method is unbiased, and that the precision is better than the significant digit of the input value. Then, we study experimental data to learn how electron dose, sampling resolution, and statistical sampling affect precision and mean values. For single measurements using a probe corrected STEM, we find that the uncertainty in d-spacing values ranges between 1-3 pm. By measuring numerous d-spacings in an automated and statistical approach in a standard microscope session, we obtain uncertainties in mean values as low as 0.01 pm, corresponding to relative uncertainties as low as 10^{-5}. This uncertainty is comparable to those reported by X-ray diffraction measurements, and is obtained using a significantly lower sample volume, in this case ~ 10^{-3} μm^3.

[1] I. Silber, A. Azulay, A. Basha, D. Ketchker, M. Baskin, A. Yagoda, L. Kornblum, A. Kohn, Y. Dagan, Enhanced superconductivity in $SrTiO_3$-based interfaces via amorphous Al_2O_3 capping, *Phys. Rev. Mater.* **8** 084803 (2024).

[2] B. Reuven, A. Azulay, D. Levy, A. Idrees, A. Kohn, G. Markovich, Strain-Modified Chirality in Selenium-Alloyed Tellurium Nanocrystals, *Chem. Mater.* **37** (17), 6943-6952 (2025).

[3] A. Azulay, I. Silber, Y. Dagan, A. Kohn, A statistical approach for interplanar spacing metrology at a relative uncertainty below 10^{-4} using scanning transmission electron microscopy, *Micron* **190** 103783 (2025).

PARALLEL SESSIONS I: Materials Science (Thursday, May 14, 2026, 14:00)

INTERACTIONS OF AMPHIPHILIC INTERPOLYELECTROLYTE COMPLEXES WITH LIPOSOME MEMBRANES STUDIED BY ON-THE-GRID PROCESSING CRYO-TRANSMISSION ELECTRON MICROSCOPY

Sapir Rappoport[1], Michael Gradzielski[2], Yeshayahu Talmon[1]
[1]*Department of Chemical Engineering and the Russell Berrie Nanotechnology Institute (RBNI), Technion – Israel Institute of Technology, Hifa, 3200003, Israel*
[2]*Stranski-Laboratorium für Physikalische und Theoretische Chemie, Institut für Chemie, Technische Universität Berlin, Berlin, D-10623, Germany*

Amphiphilic interpolyelectrolyte complexes (IPECs), formed by electrostatic interactions between oppositely charged polyelectrolytes, have attracted a significant interest in colloid science and nanomedicine as drug delivery carriers. Compared to surfactant micelles, IPECs offer enhanced stability, while remaining sensitive to external stimuli such as pH and ionic strength. In drug delivery applications, therapeutic agents are typically encapsulated within their hydrophobic core and retained through electrostatic forces or other non-covalent interactions. A critical aspect of drug delivery is the interaction between carriers and lipid membranes, as cargo must cross cellular membranes to reach intracellular targets. Therefore, understanding not only equilibrium structures but also the interaction pathways and intermediate states of IPEC-membrane systems is essential.

To study these dynamics, we introduce a novel on-the-grid processing method for cryogenic transmission electron microscopy (cryo-TEM). In this method, small volumes of IPEC and lipid solutions are mixed directly on a grid. After blotting excess liquid, the specimen is rapidly vitrified by plunging into freezing ethane under controlled environmental conditions. By systematically varying the time delay between mixing and vitrification, structural evolution can be followed with a time resolution of approximately five seconds. Unlike scattering techniques that average over large volumes, and may miss minority species, cryo-TEM provides detailed structural information of different types of supramolecular aggregates and provides images of transient intermediates.

Using this method, we investigate the interactions between poly(diallyldimethylammonium chloride) (PDADMAC) and poly(acrylic acid) sodium salt (NaPAA) complexes with dioleoylphosphatidylcholine (DOPC) vesicles, as a model lipid membrane system. In that system, we examine how hydrophobic modification of NaPAA influences aggregation behavior and membrane binding, as well as how pH conditions modulate these interactions. When NaPAA is modified with 20% dodecyl acrylate, vesicle association is observed within minutes, accompanied by a gradual decrease in IPEC density, indicating partial polymer reorganization or release (Figure 1). Over time, distinct morphologies emerge, including elongated vesicles, invaginated two-sphere structures, and faceted vesicles. After several days, complete IPEC disassembly occurs, and only these three final structures remain.

Overall, these results demonstrate the principles of IPEC-membrane interactions and show that even small hydrophobic modifications strongly affect interaction kinetics and morphology. Such insights provide important guidelines for the systematic design of responsive polyelectrolyte-based nanocarriers.

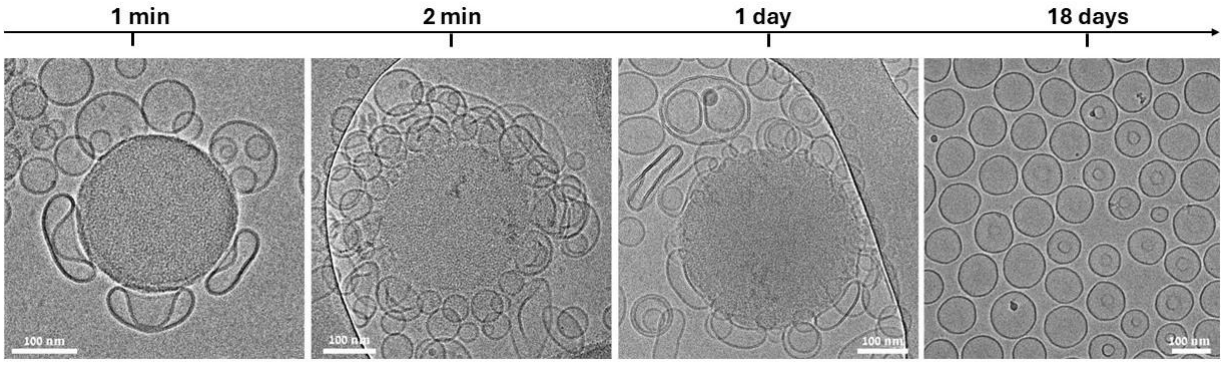


Figure 1. Cryo-TEM images of PDADMAC/ 20% hydrophobically modified NaPAA interacting with DOPC vesicles at different interaction times

PARALLEL SESSIONS I: Materials Science (Thursday, May 14, 2026, 14:00)

OVERLAY METROLOGY CHALLENGES IN ADVANCED SEMICONDUCTOR NODES

Oren Lahav
Optical Metrology Division (OMD), KLA, Migdal Haemek, Israel

Advanced semiconductor nodes face increasingly severe overlay challenges driven by continued feature-size shrinkage, reduced process margins, complex multilayer stacking, and the need for accurate on-product overlay measurements within tight manufacturing control loops. These challenges place stringent demands on overlay accuracy, precision, robustness, tool-to-tool matching, and throughput. To address these needs, KLA has developed a comprehensive portfolio of optical overlay solutions, combining high-performance technologies such as brightfield (BF) and darkfield (DF) imaging, scatterometry, advanced algorithms and data analysis. This talk outlines the fundamentals of overlay metrology, the core technologies and the anticipated challenges looking forward.

PARALLEL SESSIONS I: Frontiers in Instrumentation and Methods (Thursday, May 14, 2026, 14:00)

4D-STEM OF 2D MATERIALS AT LOW ELECTRON ENERGIES

Ofer Kfir
School of Electrical Engineering, Tel Aviv University, Tel Aviv, Israel

Electron diffraction offers local information on crystalline structure and orientation with nanometer resolution. However, the damage induced by the electron beam degrades and deforms the lattice of soft or thin materials. Ideally, one should suppress knock-on damage and maximize the elastic scattering cross-section to generate strong signal from a single or few layers.

Here we use low electron energies (2 keV – 20 keV) to form diffraction patterns from 2D materials, rastered spatially with nanometric precision (4D-STEM). Using the prototype version of a UHV compatible ultrafast scanning electron microscope (USEM). We investigate two systems: tungsten disulfide trianglular crystals (WS2) [1] on quantifoil carbon layer (Ted pella 658-300-CU), and few-layer graphene (Ted Pella 21720). When imaging the WS2 triangular domains at 20 keV, the electrons penetrate the 20 nm quantifoil enabling collection from both top and bottom, where secondary electron (SE) signal collected by the in-column detector (subfigure(a)) visualizes only the top-laying WS2 crystals. Interestingly, the crystals are nearly aligned. We focus on a slight misalignment, 2.5°, marked by A and B in subfigure (b), and form an orientation sensitive dark field (DF) image in subfigure (c). The crystals that appear only on the DF have transferred to the bottom part of the quantifoil.

The graphene on lacey carbon (subfigures (d-f)) are analyzed using 2 keV electrons as a testbed for the sensitivity of low keV electrons for 4D-STEM. The SE image (subfigure (d)) shows the segment for which the 4D-STEM was conducted. We find two main orientations. The brightness of the diffraction peaks marked “1” and “2” in the DF subfigure (e) indicate that there are double- and single-layer areas on the sample, respectively. The orientations are imaged as green and blue, so the white region in the DF includes both. Clearly, the diffraction peaks of even a single graphene layer are extremely bright at 2 keV.

To conclude, the demonstration of accurate structural and orientation analysis of atomically thin materials using the few-keV beam within a USEM would open a path to challenging experiments of phase changing layered materials, and the differentiation of the dynamics of individual layers within a heterostructure.

[1] A. Cohen et al., Tungsten Oxide Mediated Quasi-van der Waals Epitaxy of WS2 on Sapphire, ACS Nano 17, 5399 (2023).

Acknowledgments: We gratefully acknowledge the invaluable help of Dr. Murat Sivis from the University of Gottingen and MPInat Gottingen and Dr. Ariel Ismach from Tel Aviv University. This research was supported by The Israel Science Foundation (grant No. 2992/24 and 1021/22) and the Young Faculty Award from the National Quantum Science and Technology program of the Israeli Planning and Budgeting Committee.

Margulis: UNSUPERVISED MACHINE LEARNING AND 4D-STEM FOR ELUCIDATING HIDDEN STRUCTURAL DISORDER IN NANOMETER SCALES

Daniel Khaykelson[1], Gabriel Diab[2], Sidney Cohen[1], Tamar Kashti[1], Tatyana Bendikov[1], Iddo Pinkas[1], Ivo Teixeira[2], Nadezda Tarakina[3], Lothar Houben[1], Boris Rybtchinski[1]

[1]*Weizmann Institute, Rehovot, Israel*
[2]*Federal University of Sao Carlos, Sao Carlos, Brazil*
[3]*INM-Leibniz Institute for New Materials, Saarbruken, Germany*

Structurally heterogeneous materials, such as 2D layered crystalline networks, present major challenges for characterization due to their complex nanoscale order. Sodium poly(heptazine imide) (NaPHI), a carbon nitride photocatalyst, exemplifies this structural complexity. While bulk crystal structures can be inferred using powder X-ray diffraction (PXRD), obtaining specific insight into nanoscale structural heterogeneity remains challenging. Standard diffraction analysis struggles with highly disordered materials because diffuse scattering features—such as halos, arcs, lines, and speckles—are difficult to interpret. To address this, we developed a methodology that bridges bulk and nanoscale structural analysis by integrating energy-filtered four-dimensional scanning transmission electron microscopy (4D-STEM) with advanced machine learning. Measurements were conducted under low-dose conditions using direct electron detection to preserve the beam-sensitive NaPHI framework. To isolate the subtle diffuse scattering features from the noisy diffraction patterns, we applied Meta`s Segment Anything Model (SAM) marking the first time this model has been successfully utilized for 4D-STEM data analysis. Unlike conventional computer-vision methods that require prior assumptions about feature geometry, SAM provides unsupervised feature extraction without any initial structural bias.

By converting the resulting segments into spatially localized masks, we categorized features based on physical properties, completely reframing feature extraction from manual parameter tuning to domain-expert curation. The SAM-assisted analysis successfully extracted non-trivial diffuse lines connecting systematic rows of Bragg reflections. Combining this isolated data with multislice simulations (using the abTEM code), we revealed that NaPHI contains a previously unreported wave-like deformation propagating perpendicular to the stacking direction1. While SAM proved highly effective for uncovering the wave-like structural distortions in NaPHI, the methodology still required a "human in the loop" to curate and select the generated segmentation masks. To streamline and fully automate this analysis for broader datasets, we expanded our workflow to incorporate self-supervised (SS) learning and clustering architectures.

The self-supervised approach effectively maps the same multi-domain architectural features and orientational dependencies as the SAM-based method. However, the SS clustering achieved these structural mappings significantly faster and autonomously, removing the computational bottleneck of human intervention while maintaining high fidelity to the underlying physical data. Integrating low-dose 4D-STEM with data-driven machine learning (both SAM and fully automated SS clustering) establishes a broadly applicable and statistically robust methodology for resolving nano- and mesoscale order inhomogeneities. This framework minimizes user bias, enhances feature discovery, and provides the materials science community with a powerful analytical tool to uncover hidden structural motifs—such as wave-like distortions and angular misalignments—in a wide range of semi-crystalline materials.

References: [1] Khaykelson, D., et al. (2025). Elucidating Structural Disorder in a Polymeric Layered Material: The Case of Sodium Poly(heptazine imide) Photocatalyst. Nano Letters, 25, 17230-17236.

PARALLEL SESSIONS I: Frontiers in Instrumentation and Methods (Thursday, May 14, 2026, 14:00)

PHYSICS-INFORMED SELF-SUPERVISED GENERATIVE MODEL FOR 3D LOCALIZATION MICROSCOPY

Ofri Goldenberg
Technion, Haifa, Israel

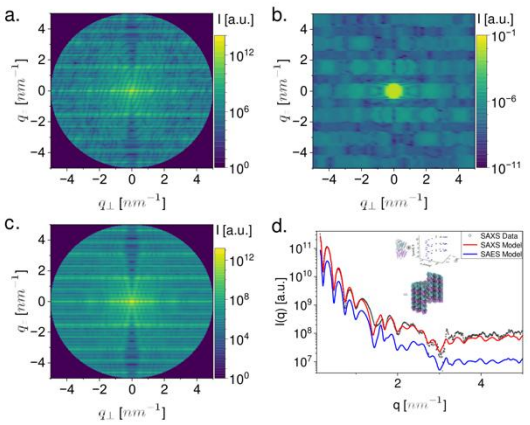
Localization microscopy has overcome the diffraction limit, i.e. the conventional resolution limit of a microscope, enabling nanoscale biological imaging by precisely determining the positions of individual emitters such as single fluorescent molecules. However, the performance of deep learning methods, commonly applied to these tasks, depends significantly on the quality of training data, typically generated through simulation. Creating simulations that perfectly replicate experimental conditions remains challenging, resulting in a persistent simulation-to-experiment gap. To bridge this gap, we propose a physics-informed generative model leveraging self-supervised learning directly on experimental data. Our model extends the Deep Latent Particles (DLP) framework by incorporating a physical model of the Point Spread Function (PSF; the image of a single point source in the microscope) into the decoder, enabling it to disentangle learned realistic environments from emitters. Trained directly on unlabeled experimental images, our model intrinsically captures realistic background, noise patterns, and emitter characteristics. The decoder thus acts as a high-fidelity generator, producing fully labeled, realistic training images with known emitter locations. Using these generated datasets significantly improves the performance of supervised localization networks, particularly in challenging scenarios such as complex backgrounds and low signal-to-noise ratios. We demonstrate our approach on a variety of experimentally measured microscopy data, including super-resolution imaging in 2D and 3D and particle tracking in live cells, showing substantial improvements in localization precision and emitter detection. The code will be made publicly available.

PARALLEL SESSIONS I: Frontiers in Instrumentation and Methods (Thursday, May 14, 2026, 14:00)

E+: SOFTWARE FOR HIERARCHICAL MODELING OF ELECTRON SCATTERING FROM COMPLEX STRUCTURES

Eytan Balken[1], Daniel Khaykelson[4], Itai Ben-Nun[1], Yael Levi-Kalisman[2,3], Lothar Houben[5], Boris Rybtchinski[4], Uri Raviv[1,3]
[1]*Institute of Chemistry, The Hebrew University of Jerusalem, Jerusalem, Israel*
[2]*Institute of Life Sciences, The Hebrew University of Jerusalem, Jerusalem, Israel*
[3]*Center for Nanoscience and Nanotechnology, The Hebrew University of Jerusalem, Jerusalem, Israel*
[4]*Department of Molecular Chemistry and Materials Science, Weizmann Institute of Science, Rehovot, Israel*
[5]*Department of Chemical Research Support, Weizmann Institute of Science, Rehovot, Israel*

In modern nanobeam transmission electron microscopy methods such as 4D-STEM, a converged electron nanobeam is scanned across a sample. Its 2D scattering pattern is recorded at each sample position, mapping the local sample structure. One of the bottlenecks in electron scattering is the analysis of the scattering data, obtained from complex atomic or molecular structures. On the basis of D+ software, we developed the software E+ for analyzing electron scattering data, enabling us to model the 2D scattering pattern from any complex structure in a single orientation or a fiber. In addition, the azimuthally integrated 1D scattering curve of isotropically oriented structures (as in solutions or powders), or any other distribution of orientations can also be computed. E+ allows the docking of geometric and/or molecular atomic models into their assembly symmetry. The assembly symmetry includes the rotations and the translations of repeating subunits in a large structure. This process can be repeated hierarchically, using a bottom-up approach, adding as many subunits as needed. This procedure can be used to model the scattering data from any complex supramolecular structure at any spatial resolution, down to atomic resolution. In addition, the contribution from the solvation layers of structures in solutions can be computed in a scalable manner for large complexes. Furthermore, the Python API of E+ can be used for advanced modeling of structure factor and pair distribution functions, taking into account various effects, including thermal fluctuations, polydispersity of any structural parameters, or the intermolecular interactions between subunits. We validate E+ against abTEM software and show a few examples, demonstrating how E+ can be used to analyze 4D-STEM electron scattering data.


a.
b.
c.
d.
I [a.u.]
$q_\perp$ [nm^{-1}]
q [nm^{-1}]
I(q) [a.u.]
SAXS Data
SAXS Model
SAES Model

PARALLEL SESSIONS I: Frontiers in Instrumentation and Methods (Thursday, May 14, 2026, 14:00)

TOWARDS A COMPACT SUB-100-MEV SEM ELECTRON SPECTROMETER

Hussam Salameh[1], Roy Shiloh[1]
Applied Physics, Hebrew University, Jerusalem, Israel

High-resolution electron energy spectroscopy is a fundamental requirement across diverse scientific fields, ranging from material characterization and chemical analysis to the interaction of free electrons and photons. The ability to resolve minute energy shifts is critical for capturing the fine details of electron-matter interactions and confirm such novel quantum theories in experiment.

Scanning electron microscope (SEM) vendors do not offer electron spectrometers tailored for SEMs, for the simple reason that at these low energies, material scientists, chemistry- and biology-related research is nearly non-existent. This also applies to novel research in electron-photon interaction, which has recently attracted much attention [1,2]. Recently, a breakthrough double-sector high-resolution magnetic spectrometer system capable of resolving individual photons was demonstrated in an SEM [3], which demonstrated quantum electron-light phenomena in an SEM by direct measurement.

In this novel work, we will discuss the systematic design of a 90-degree dipole sector magnet aiming at measuring electrons with a nominal energy of 30 keV and a resolution well-below 100 meV. The device is planned for maximizing the electron current throughput also at this high-resolution while maintaining a compact device volume suitable for SEMs. Certain detrimental effects such as fringe-field distortion, geometric and chromatic aberrations will be carefully treated. By employing electromagnetic theory and exact magnetic field and particle-tracking simulations, we investigate the interplay between the available geometric parameters and degrees-of-freedom and the physical constraints in such systems. Our work provides a simulation-based blueprint for a compact, high-performance spectrometer, which will be the basis for asserting novel quantum light-matter theories.

[1] B. Barwick, D. J. Flannigan, and A. H. Zewail, Photon-induced near-field electron microscopy, Nature 462, 902 (2009).

[2] S. T. Park, M. Lin, and A. H. Zewail, Photon-induced near-field electron microscopy (PINEM): theoretical and experimental, New Journal of Physics 12, 123028 (2010).

[3] R. Shiloh, T. Chlouba, and P. Hommelhoff, Quantum-Coherent Light-Electron Interaction in a Scanning Electron Microscope, Physical Review Letters 128, 235301 (2022).

PARALLEL SESSIONS I: Frontiers in Instrumentation and Methods (Thursday, May 14, 2026, 14:00)

SUPER-RESOLVED INTEGRATED CRYO-FLUORESCENCE IMAGING ON LAMELLA FOR PRECISION CRYO-ET

Ben Lich[1], Marit Smeets[1], Max Kaag[1], Deniz Daviran[1], Elli Johnston[1], Arjen Jakobi[2]
[1]*Life Sciences, Delmic BV, Delft, Netherlands*
[2]*Bionanoscience, TU Delft, Delft, Netherlands*

Cryo focused ion beam (cryo-FIB) milling expands the range of biological samples accessible to cryo-electron tomography (cryo-ET). METEOR 2.0 is Delmic's integrated cryo-fluorescence microscope (cryo-FM), utilizing high-NA objectives and LED imaging for high-sensitivity, non-destructive fluorescence imaging throughout the FIB milling process. We investigated the resolving power of METEOR 2.0 imaging in combination with a super-resolving technique, enhanced Super-Resolution Radial Fluctuations (eSRRF) [2]. While super-resolution has been demonstrated on stand-alone cryo-FMs [3-4], this is the first demonstration of super-resolution in an integrated cryo-FM.

We used METEOR 2.0 to acquire fluorescence timelapses of DNA-origami nanorulers with precisely defined fluorophore separations under cryogenic conditions. eSRRF post-processing yielded a 2-fold improvement in lateral resolution. As a proof-of-concept, we applied the METEOR 2.0 - eSRRF workflow to co-localizing fluorescent puncta in lamellae of mRFP-GFP-LC3 HeLa cells. METEOR 2.0 imaging revealed co-localizing fluorescent puncta clearly in polished lamellae, and eSRRF processing sharpened structures and improved peak separation, validating colocalization. The super-resolved fluorescence images correlated closely with distinct organelles visible when imaged in TEM. Together, this work demonstrates that the METEOR 2.0 and eSRRF workflow overcomes the diffraction barrier and improves effective resolution. This setup enables precise, fluorescence-guided cryo-ET acquisition, and strengthens target validation of features below the diffraction limit.

PARALLEL SESSIONS I: Frontiers in Instrumentation and Methods (Thursday, May 14, 2026, 14:00)

ENABLING NON-INVASIVE, MULTIPLEXED, LONG-TERM OBSERVATION OF CELLULAR PROCESSES VIA LABEL-FREE LIVE IMAGING AND IN SILICO LABELING

Assaf Zaritsky
Institute for Interdisciplinary Computational Science, Ben-Gurion University of the Negev, Be'er-Sheva, Israel

Uncovering the complex mechanisms of cellular processes requires continuous measurement of a cell's physiological state and subcellular organization over time. However, phototoxicity and photobleaching prevent long-term, rapid fluorescence imaging of multiple structures simultaneously. In silico labeling, the computational translation of label-free microscopy into virtual fluorescent images, offers a minimally invasive alternative. Despite its potential, practical adoption is stalled by three gaps: structural inaccuracies, limited generalization across diverse biological contexts, and a lack of interpretability. In this talk, I will present three synergistic methods designed to transform in silico labeling into a rigorous scientific instrument. First, I will introduce DM4ISL, a diffusion-based model that achieves highly accurate, uncertainty-aware predictions by resolving the entanglement between biological signal and photon noise. Second, I will present CELTIC, which incorporates biologically meaningful cell contexts to harmonize datasets and enable accurate predictions in out-of-distribution data. Finally, I will describe Mask Interpreter, a method for semantic visual interpretability that uncovers organelle-specific "explanation signatures", providing the necessary evidence-based trust for downstream discovery. Together, these advancements bridge the gap between computational inference and reliable cell biology, providing a window into cellular dynamics with unprecedented detail and duration.

PARALLEL SESSIONS II: Life Sciences (Thursday, May 14, 2026, 16:00)

DYING TO PROTECT – NINJURINS, THE HEROES OF THE IMMUNE SYSTEM

Liron David
Ben-Gurion University of the Negev, Department of Life Sciences, Beer-Sheva, Israel

Ninjurin1 (NINJ1) and Ninjurin2 (NINJ2) are multi-pass plasma membrane proteins that induced by nerve injury to increase cell adhesion and promote axonal growth in neurons. Recently, it was established that NINJ1 is essential for several programmed cell death pathways, by promoting membrane rapture, downstream of gasdermin D pore formation. We uncovered the moleculer mechanism of NINJ1 in pyroptosis by combining cryo-EM, confocal and super-resolution imaging. We successfully purified oligomeric NINJ1 and NINJ2 in detergent as irregular rings as well as curved filaments. In liposomes, while NINJ1 and NINJ2 both formed ring-like structures when mixed with liposomes, strikingly, only NINJ1, but not NINJ2, ruptures liposome membranes. We determined the cryo-EM structure of NINJ1 ring segments from detergent. Each NINJ1 subunit contains a transmembrane (TM) helical hairpin that likely mediates NINJ1 membrane localization, as well as two extracellular domain amphipathic helices NINJ1 oligomer possesses a concave hydrophobic side that should face the membrane and a convex hydrophilic side formed by amphipathic helices presumably upon activation. Moreover, live cell and super-resolution imaging reveled ring-like structures on the plasma membrane and released into the culture supernatant. Released NINJ1-encircled disks contain membrane inside shown by lipid staining. Therefore, NINJ1-mediated membrane rupture uses a mechanism different from gasdermin-mediated pore formation, acting as a “cookie cutter” that lead to membrane rupture and lytic cell death. Furthermore, although it was shown that NINJ1 is the terminal executioner of cellular rupture in multiple lytic cell death pathways, its activation trigger, however, remains unknown. We found that NINJ1-mediated plasma membrane rupture depends on calcium influx into the cell, which suffices to induce NINJ1-mediated rupture through direct and indirect mechanisms.

PARALLEL SESSIONS II: Life Sciences (Thursday, May 14, 2026, 16:00)

CONTINUOUSLY CONTROLLED SPECTRAL (COCOS) MICROSCOPY: FROM HIGH-THROUGHPUT SINGLE MOLECULE MULTIPLEXING TO HIGH-RESOLUTION MULTI-COLOR IMAGING

Yuval Ebenstein[1], Jonathan Jeffet[1], Jasline Deek[1], Nadav Tenenboim[1], Lanna Bery[1]
Physical Chemistry, Tel Aviv Uninversity, Tel Aviv, Israel

Introduction

Fluorescence microscopy offers a rich view of molecular processes by lalbeling different entities with colors. Yet distinguishing between multiple colors often forces a compromise between acquisition simultaneity, speed, signal quality, and field of view. To address this, we developed a compact spectral imaging framework that allows us to adjust the level of spectral separation to the needs of each experiment, optimizing the balance between throughput and spectral resolution. By optimizing the spectral resolution to the minimal dispersion, we maximize both spatial and spectral information contents.

Methods

Spectral control was implemented with a simple add-on module to standard fluorescent microscopes. Paired Amici prisms were placed on motorized rotators to control and optimize the induced spectral dispersion in an automated manner (figure 1). We applied our compact spectral imaging module to single-molecule applications including: single molecule FRET, single molecule spectroscopy, machine-learning based multiplexed single-molecule RNA expression quantification by spectral barcode readout (figure 2). Finally, we coupled a custom-designed Amici prism with image-scanning microscopy (ISM) on a spinning-disk platform for simultaneous multi-color super-resolution imaging (figure 3).

Results

We demonstrate the versatility of this approach across several single-molecule and translational applications including: wide-field single-molecule FRET with 6-fold enhanced throughput, spectral imaging of multiple fluorophores within a single detection window, and single molecule RNA expression machine-learning based quantification showcasing clinical diangnostic capability. Finally, I will present our latest results, demonstrating high-resolution cellular imaging by tailoring the spectral dispersion in a confocal spinning-disk image-scanning microscopy (ISM-CSD) setup. This implementation allows simultaneous multi-color high-resolution imaging, reducing temporal artefacts and improving multi-color acquisition speed.

Discussion

Across these examples, controlled spectral resolution enables to enhance both throughput and multiplexing capability with densely labeled samples. Together, these results highlight compact spectral imaging as a broadly applicable, user-adaptable strategy for multiplexed biophotonics. From single molecules to complex cellular systems, it holds promise for applications in cell biology, molecular imaging, and other fields requiring detailed multi-color visualization at the nanoscale.

PARALLEL SESSIONS II: Life Sciences (Thursday, May 14, 2026, 16:00)

QUANTIFYING POPULATION REVERSIBILITY OF SENSOR PERFORMANCE IN MULTI-CYCLE SINGLE-SENSOR RECOVERY ASSAY

Geffen Rosenberg[1], Gili Bisker[1,2,3,4,5]
[1]*School of Biomedical Engineering, Tel Aviv University, Tel Aviv, Israel*
[2]*Center for Physics and Chemistry of Living Systems, Tel Aviv University, Tel Aviv, Israel*
[3]*Center for Nanoscience and Nanotechnology, Tel Aviv University, Tel Aviv, Israel*
[4]*Center for Light-Matter Interaction, Tel Aviv University, Tel Aviv, Israel*
[5]*Sagol School of Neuroscience, Tel Aviv University, Tel Aviv, Israel*

Monitoring chemical messengers in living systems requires sensors that are not only sensitive and selective but also capable of providing spatiotemporal information on the presence of these messenger biomolecules. From synaptic neurotransmission to paracrine signaling and oxidative bursts, these events are transient, localized, and repeated, favoring imaging-based readouts with cellular and subcellular resolution over conventional ensemble assays. In such cases, sensors must report reliably across many exposure-wash cycles, so that quantitative maps of concentration and dynamics can be trusted over time.

Single-walled carbon nanotubes (SWCNTs) have emerged as a powerful optical biosensing platform, capable of detecting and continuously monitoring a variety of target analytes. SWCNTs fluoresce in the near infrared (NIR), coinciding with the biological optical transparency window, and do not exhibit photobleaching or blinking. Upon tailored surface functionalization, SWCNTs respond to the binding of a specific analyte with modulation in fluorescent emission (Fig. 1). By leveraging NIR fluorescent imaging, SWCNT sensors provide a non-invasive, photostable, and highly sensitive platform for detecting analytes with high spatial resolution.

The nanoscale of SWCNT enable single-sensor imaging with exceptional spatiotemporal resolution for detecting analyte presence. Recent work has leveraged this capability to monitor plant health, track reactive oxygen species in photoaged skin cells, visualize neurotransmitter release in neuronal systems, and probe the gastrointestinal tract within C. elegans worms. In practice, the same SWCNT endures multiple analyte exposures, so quantitative readouts require reversibility, recovery, and consistent response. While reversibility has been shown qualitatively for several SWCNT sensor constructs, a quantitative analysis of single-sensor recovery across repeated challenges is lacking. We address these gaps by systematically characterizing multi-cycle reversibility of individual SWCNTs in a controlled microfluidic platform. [1]

To quantify sensor reversibility, we immobilized SWCNT-based sensors in a flow channel, and alternately exposed them to analytes, like dopamine (DA), followed by a buffer wash, in a controlled, cyclic manner, while imaging them with a NIR fluorescence microscope. Figure 1A presents fields of view (FOVs) of NIR fluorescence images before and after DA addition in each of the 4 cycles of the flow experiment, demonstrating the distinct increase in sensor fluorescence in response to analyte, and the deacrease with buffer wash. Figure 2A presents the mean FOV fluorescence intensity traces through flow experiments with different analyte concentrations, showing that the fluorescence response increases with analyte concentrations, demonstrating the quantitative nature of the sensor's response.

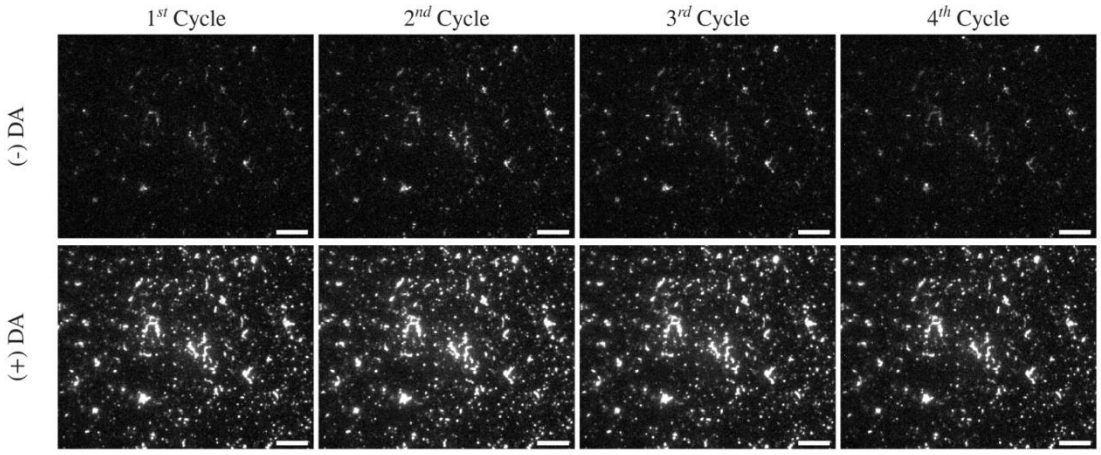


Figure 1. Immobilized SWCNTs before (top) and after (bottom) 100 µM DA introduction in each cycle. Scale bar=10 µm.

To evaluate the reversibility of single sensors, we segmented regions of interest (ROIs) containing few or individual SWCNTs (Figure 1C). The ROI population varied in size, fluorescence response, and reversibility (Figure 1C i-ii). To quantify the sensors' reversibility based on heterogeneous single sensor population, we developed a Population Reversibility Score (PRS) based on Relative Entropy, which measures the statistical distance between two probability distributions. By applying relative entropy on the response distributions of the ROI populations from the first and later cycles, we were able to measure the change in sensor's response, and grade its reversibility. Fig 1C presents the PRS, with a score of 1 and 0 representing perfect and no reversibility respectively, showing dependency on both analyte concentration and number of exposures.

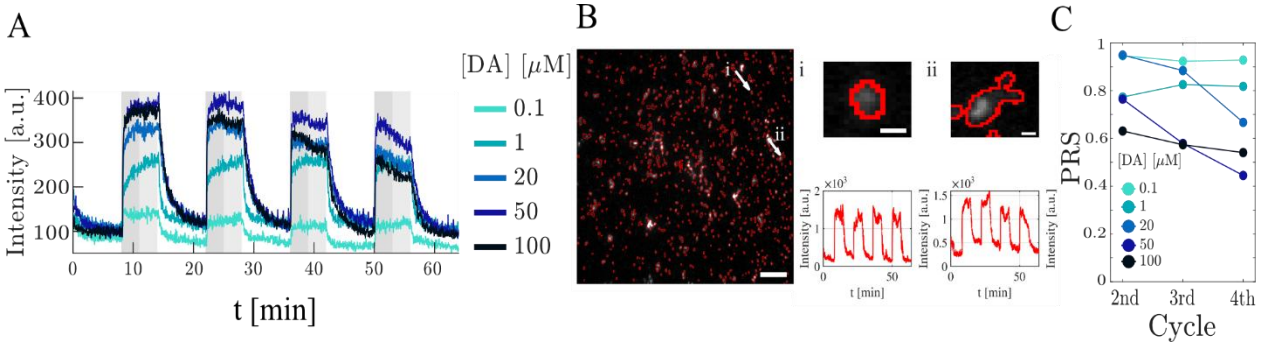


Figure 2. (A) Mean FOV fluorescence in flow experiments with different analyte concentrations. Dark grey, light grey and white backgrounds represent analyte flow, stop-flow buffer wash sections respectively. (B) Segmented ROIs of individual SWCNTs in flow experiments of (GT)15-SWCNT with 100 µM DA (Scale bar = 10 µm), with (i, ii, iii) three individual ROIs (scale bar = 500 nm) and their mean fluorescence intensity over time. (C) Reversibility Score of normalized fluorescence response of the DNA-SWCNTs to varying DA concentration across exposure cycles.

By establishing the first Population Reversibility Score (PRS), we provide a standardized metric to evaluate how single-sensor populations recover across repeated analyte exposures, allowing researchers to distinguish true biological signaling from sensor degradation, ensuring that imaging data can be confidently translated into accurate concentration maps for dynamic biological processes.

1. Rosenberg, G. & Bisker, G. 2025.12.25.696491 Preprint at https://doi.org/10.64898/2025.12.25.696491 (2025).

PARALLEL SESSIONS II: Life Sciences (Thursday, May 14, 2026, 16:00)

ADVANCED CRYO-STET IMAGING: FISHING FOR THE MTDNA IN SITU

Peter Kirchweger[1], Shahar Seifer, Lev Melnikovsky, Shahar Seifer[1], Lev Melnikovsky[1], Michael Elbaum, Michael Elbaum[1]
Department of Chemical and Biological Physics, Weizmann Institute of Science, Rehovot, Israel

Cryo-STET employs a focused electron probe that is rastered across a vitrified specimen while scattered electrons are recorded by bottom-mounted pixelated or area detectors [1, 2]. Tomographic data acquisition is performed using SerialEM [3]. Using the pixelated Dectris ARINA detector, we established 4D cryo-STET [4] and recently expanded the methodology by implementing shadow-montage reconstruction [5]. Shadow-montage stitches together many tiny shadow images produced in the diffraction plane during scanning with a defocused electron beam, enhancing spatial resolution while maintaining a large field of view. By adjusting how those shadows are aligned it can also reconstruct different depths of the sample. For azimuthal-segmented area detectors, we developed cryo-STET methods based on parallax-corrected bright-field (pBF) and parallax-filtered integrated differential phase contrast (πDPC) imaging [6, 4, 7].

In addition, I will present recent developments in three-dimensional deconvolution (3dcon), which we developed for cryo-STET [8, 9] and TEM-based cryo-electron tomography [10]. This approach reduces structural “salt-and-pepper” noise and partially compensates for the missing wedge in tomographic reconstructions. Applications of 3dcon to both TEM-based cryo-ET and cryo-STET datasets will be shown.

I will briefly introduce the principles of shadow-montage reconstruction, pBF, and πDPC imaging, and demonstrate their application to targeting mitochondrial genome (mtDNA) in situ. The mtDNA has been a deeply studied topic for some time, including by cryo-ET [11]. Direct visualization with cryo-ET was not possible due to the radiation sensitivity of the mtDNA [11]. The mitochondrial genome serves here as a representative example demonstrating the potential of cryo-STET for studying macromolecular organization within intact cellular environments.

References

1. Wolf, S. G. et al. Nature methods 11 (Apr. 16, 2014).
2. Kirchweger, P. et al. en. Journal of visualized experiments: JoVE (June 23, 2023).
3. Mastronarde, D. N. Microscopy and microanalysis: the official journal of Microscopy Society of America, Microbeam Analysis
Society, Microscopical Society of Canada 9 (Aug. 24, 2003).
4. Seifer, S. et al. en. Microscopy and microanalysis: the official journal of Microscopy Society of America, Microbeam Analysis
Society, Microscopical Society of Canada 30 (July 4, 2024).
5. Seifer, S. et al. bioRxiv (Sept. 11, 2025).
6. Seifer, S. et al. Microscopy and microanalysis: the official journal of Microscopy Society of America, Microbeam Analysis So-
ciety, Microscopical Society of Canada 27 (Dec. 11, 2021).
7. Kirchweger, P. et al. bioRxiv (Nov. 29, 2025).

8. Waugh, B. et al. Proceedings of the National Academy of Sciences of the United States of America 117 (Nov. 3, 2020).
9. Kirchweger, P. et al. en. Journal of Structural Biology 215 (Sept. 30, 2023).
10. Croxford, M. et al. Proceedings of the National Academy of Sciences 118 (Dec. 14, 2021).
11. Kukat, C. et al. en. Proceedings of the National Academy of Sciences of the United States of America 112 (Sept. 8, 2015).

PARALLEL SESSIONS II: Life Sciences (Thursday, May 14, 2026, 16:00)

THE LAST 2 HOURS BEFORE DEATH: MULTISCALE SPATIOTEMPORAL CHARACTERIZATION OF COLLECTIVE CELL DEATH

Esraa Nsasra[1], Orit Kliper-Gross[1], Denis Streltsovski[1], Jyotirekha Das[2], Saloni K. Hombalkar[2,3], Michael Overholtzer[2,3,4], Assaf Zaritsky[1]
[1]*Institute for Interdisciplinary Computational Science, Faculty of Computer and Information Science, Ben-Gurion University of the Negev, Beer-Sheva, Israel*
[2]*Cell Biology Program, Memorial Sloan Kettering Cancer Center, New York, NY, USA*
[3]*BCMB Graduate Program, Weill Cornell Medical College, New York, NY, USA*
[4]*Gerstner Sloan Kettering Graduate School of Biomedical Sciences, Memorial Sloan Kettering Cancer Center, New York, NY, USA*

Programmed cell death (PCD) is a fundamental biological process that shapes tissue homeostasis and development[1]. Among the diverse modes of PCDs, apoptosis and ferroptosis differ in their molecular pathways and morphological features. While apoptosis has long been considered a predominantly cell-autonomous process, emerging evidence suggests that ferroptosis can propagate across neighboring cells and affect cell populations[2–4]. However, how a cell's commitment to a specific death mode translates into collective death at the population scale remains largely unknown.

Live-cell imaging enables real-time monitoring of dying cells, providing a powerful means to study death progression at single-cell and population resolutions[5]. Experimentally, determination of timing and mode of committed death typically relies on pathway-specific fluorescent reporters, such as caspase activation reporters in apoptosis[2]. However, conventional fluorescent reporters present significant limitations, including challenges in identifying pathway-specific target proteins and technical constraints such as photobleaching, phototoxicity, and genetic modification, which can perturb native cellular physiology[5]. Moreover, universal cell death reporters, such as Sytox, detect death at late-stages, making early commitment to a specific death mode difficult to resolve. Consequently, despite advances in live-cell imaging, current approaches fall short in detecting early commitment across diverse PCD modes, and subsequently characterizing their spatiotemporal dynamics, directly from cellular morphology, without dependence on fluorescent reporters.

Here, we introduce a computational image-based approach that establishes a label-free marker of cell death progression at single cell resolution. By integrating live-cell imaging, deep learning, cell biology, and quantitative analysis, our method learns the temporal progression of different death modes and enables inference of death mode and timing directly from label-free images. Our preliminary results support distinct progression patterns between death modes at single-cell resolution. Specifically, ferroptosis progresses more gradually than apoptosis, with early ferroptosis-associated morphological changes detectable by our method up to two hours before loss of membrane integrity. In contrast, apoptotic commitment could be identified only about 30 minutes prior to the final stages of death. Beyond single-cell resolution, our label-free marker will enable mapping of death progression across space and time within cell populations, providing a framework to quantify how cellular heterogeneity and local interactions shape collective versus autonomous death. These advances will have broad implications for deciphering cell population behavior in homeostasis, development, and disease, ultimately enhancing our ability to therapeutically modulate cell death.

References:

1. Strasser, A. & Vaux, D. L. Cell Death in the Origin and Treatment of Cancer. Mol. Cell 78, 1045–1054 (2020).

2. Eroglu, M. & Derry, W. B. Your neighbours matter - non-autonomous control of apoptosis in development and disease. Cell Death Differ. 23, 1110–1118 (2016).

3. Riegman, M., Bradbury, M. S. & Overholtzer, M. Population Dynamics in Cell Death: Mechanisms of Propagation. Trends Cancer Res. 5, 558–568 (2019).

4. Co, H. K. C., Wu, C.-C., Lee, Y.-C. & Chen, S.-H. Emergence of large-scale cell death through ferroptotic trigger waves. Nature 631, 654–662 (2024).

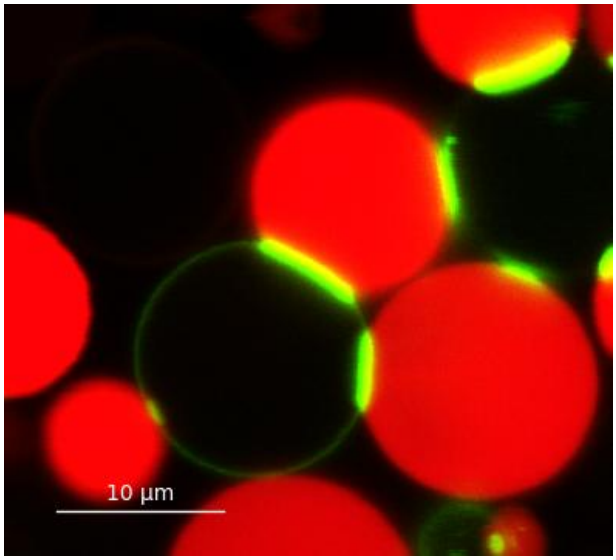
5. Pylvänäinen, J. W., Gómez-de-Mariscal, E., Henriques, R. & Jacquemet, G. Live-cell imaging in the deep learning era. Curr. Opin. Cell Biol. 85, 102271 (2023).

PARALLEL SESSIONS II: Life Sciences (Thursday, May 14, 2026, 16:00)

A PLASMA MEMBRANE VESICLE IMAGING-BASED PLATFORM FOR STUDYING MEMBRANE FUSION

Inbar Yosibash[1,2], Suman Khan[3], Alisa Vaknin[1,2], Raviv Dharan[1,2], Alexandra Lichtenstein[4], Gonen Golani[5], Susan Daniel[6], Ori Avinoam[3], Raya Sorkin[1,2]
[1]*School of Chemistry, Tel Aviv University, Tel Aviv, Israel*
[2]*Center for Physics and Chemistry of Living Systems, Tel Aviv University, Tel Aviv, Israel*
[3]*Department of Biomolecular Sciences, Weizmann Institute of Science, Rehovot, Israel*
[4]*Cellular and Molecular Imaging Center, Faculty of Medicine, Tel- Aviv University, Tel Aviv, Israel*
[5]*Department of Physics, University of Haifa, Haifa, Israel*
[6]*Robert Frederick Smith School of Chemical and Biomolecular Engineering, Cornell University, Ithaca, USA*

Membrane fusion is central to biological processes such as viral entry, fertilization, and cell-to-cell fusion. Gaining a mechanistic understanding of fusion requires the ability to visualize and quantify the dynamic interaction between two membranes and their associated protein machineries at high temporal and spatial resolution. However, studying these processes in live cells remains challenging due to the complexity of the cellular environment. Here, we demonstrate a versatile cell-free platform based on giant plasma membrane vesicles that enables controlled, quantitative analysis of receptor binding and membrane fusion kinetics in a native membrane context. As proof of concept, we reconstitute the SARS-CoV-1 Spike-ACE2 interaction, capturing specific receptor engagement and accumulation at the membrane interface using confocal microscopy and micropipette aspiration. Fusion was induced by proteolytic activation and quantified using both high-resolution microscopy and high-throughput imaging flow cytometry. The platform also reveals the influence of membrane composition on fusion efficiency, demonstrated by the impact of cholesterol depletion. This approach provides a broadly applicable system for dissecting membrane fusion and protein-protein interactions across membranes, with compatibility for biophysical, imaging, and structural analysis. It offers new opportunities for mechanistic studies and inhibitor screening in a biologically relevant yet experimentally accessible context.



Yosibash, I., et al., A Versatile GPMV-Imaging Platform for Quantitative Analysis of Receptor Binding and Membrane Fusion. Biophys J, 2025.

PARALLEL SESSIONS II: Life Sciences (Thursday, May 14, 2026, 16:00)

OLIGOMER PLASTICITY: AN EMERGING NEW MECHANISM IN MEMBRANE PROTEINS?

Shifra Lansky[1]
Weizmann Institute of Science, Rehovot, Israel

Membrane proteins are traditionally viewed as having fixed oligomeric stoichiometries that are tightly coupled to function. However, using high-speed atomic force microscopy (HS-AFM) and single-particle cryo-EM, we discovered that the TRPV3 ion channel, previously considered a strictly tetrameric assembly, can also adopt a rare pentameric state. Importantly, this pentameric form is dynamic and can reversibly interconvert with the tetramer through membrane-diffusive subunit exchange, revealing a previously unrecognized level of structural flexibility. These findings suggest that TRPV3 exists in a dynamic equilibrium between distinct oligomeric states rather than a single fixed assembly. Emerging structural evidence indicates that similar behavior may also occur in other membrane proteins of diverse functions. We term this phenomenon oligomeric plasticity and propose that it may represent a new structure-function paradigm, enabling membrane proteins to diversify function, regulate activity, and respond dynamically to changing physiological and pharmacological cues.

PARALLEL SESSIONS II: Materials Science (Thursday, May 14, 2026, 16:00)

VISCOELASTIC CONTROL OF ACTIVE FLOWS IN BIOINSPIRED MOTOR-FILAMENT NETWORKS

Alexandra Tayar[1]
Chemical and Biological Physics, Weizmann Institute of Science, Rehovot, Israel

Active forces are crucial in biological systems and bioinspired synthetic materials, enabling dynamic properties such as adaptability and reconfigurability. Biological processes involving motor-cytoskeleton interactions exhibit complex flow behaviors, ranging from local currents to coordinated long-range streaming. However, the mechanisms underlying transitions between these flow states remain unclear. In this study, we develop a composite material composed of microtubule-kinesin active fluids embedded within a dilute polymer network, providing a controlled platform for replicating and investigating biological dynamics. By systematically varying network elasticity, active stress, and boundary conditions, we identify transitions from chaotic local flows to globally synchronized states. Our results demonstrate that polymer length distribution critically controls the emergence of coherent flows, while increased activity transitions the system from a semi-dilute to an entangled regime. Additionally, confinement within microfluidic geometries reveals the significant influence of boundary conditions on flow modes. These insights deepen our understanding of the dynamics of active solids and provide design principles for advanced biomimetic materials.

PARALLEL SESSIONS II: Materials Science (Thursday, May 14, 2026, 16:00)

DAMSELFLIES OVERCOME COLOR SATURATION BARRIERS OF PHOTONIC GLASSES VIA PIGMENT LOADING AND REFRACTIVE INDEX MODULATION

Tali Lemcoff[1], Lotem Alus[2], Albert Batushansky[3], Yahel Fishman[1], Keshet Shavit[1], Johannes S. Haataja[4], Dan Oron[2], Benjamin A. Palmer[1,5]

[1]*Department of Chemistry, Ben-Gurion University of the Negev, Beer-Sheva, Israel*

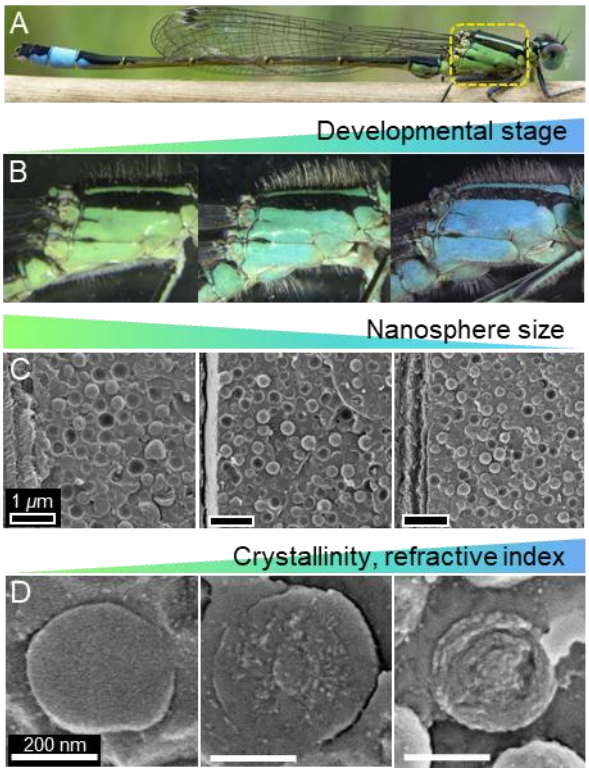
[2]*Department of Molecular Chemistry and Materials Science, Weizmann Institute of Science, Rehovot, Israel*

[3]*Ilse Katz Institute for Nanoscale Science & Technology, Ben-Gurion University of the Negev, Beer-Sheva, Israel*

[4]*Department of Applied Physics, Aalto University, Espoo, Finland*

[5]*School of Chemistry, University of Bristol, Bristol, United Kingdom*

Biological strategies for manipulating light have revealed new concepts in light scattering and inspired the design of sustainable photonic materials. Iridescent structural coloration has been extensively studied, and its underlying physical principles are well understood. However, many applications require non-iridescent structural colors, which are significantly more difficult to achieve. Photonic glasses, composed of randomly arranged dielectric spheres, offer a promising route to such angle-independent colors, but their intrinsic disorder and particle size polydispersity typically lead to poor color saturation. Here, we use cryo-SEM, TEM, electron diffraction, and complementary techniques to characterize a highly saturated and tunable photonic glass in blue-tailed damselflies. We show that the color shifts from green to blue are associated with a decrease in nanosphere size during maturation and identify biological strategies that enable the damselflies to generate unexpectedly vivid, angle-independent colors. Most notably, the refractive index of the nanospheres is modulated through changes in crystallinity, producing an almost perfectly inverse correlation with nanosphere size. As a result, the polydispersity in nanosphere size, which would normally reduce color saturation, is compensated by a correlated change in refractive index. This relationship maintains a nearly constant Mie scattering size parameter across the distribution of nanospheres. These findings reveal a design principle for overcoming saturation limitations in disordered photonic systems.



(A) The male blue-tailed damselfly (Ischnura elegans). Photo credit: Ian Kirk. (B) Thoraxes during the development. (C) Cryo-SEM images of pteridine nanospheres in the distal epidermis and (D) of nanosphere cross-sections exhibiting different stages of formation during ontogeny.

PARALLEL SESSIONS II: Materials Science (Thursday, May 14, 2026, 16:00)

CORRELATIVE IMAGING CAPTURES A FUSION MECHANISM AS THE ORIGIN OF SINGLE-CRYSTALS WITH MULTIDOMAIN APPEARANCE

Hadar Nasi[1], Maria Chiara di Gregorio[3], Ifat Kaplan-Ashiri[2], Linda J. W. Shimon[2], Xiao-Meng Sui[2], Lothar Houben[2], Katya Rechav[2], Vlad Brumfeld[2], Irit Goldian[2], Sidney R. Cohen[2], Nir Kampf[2], Michal Lahav[1], Milko E. van der Boom[1]
[1]*Department of Molecular Chemistry and Materials Science, The Weizmann Institute of Science, Rhehovot, Israel*
[2]*Department of Chemical Research Support, The Weizmann Institute of Science, Rheho, Israel*
[3]*Department of Chemistry, Sapienza University of Rome, Rome, Italy*

In this study, we unveil the formation of a novel Metal-Organic Framework (MOF), characterized by its striking multi-domain structure despite being a singular crystal (Fig 1. A,B)1. The HN-MOF exhibits unique features, including two distinct holes on each deck of the flower-like crystal, interconnected by a central stem, as evidenced by Micro-Computed Tomography (Micro-CT) data (Fig 1. C,D). Our investigation into the growth dynamics of this exceptional structure reveals the presence of particles both on and surrounding the crystal (Fig 1. E)2. These particles coalesce to form a homogeneous layer, which we analyze through a combination of advanced techniques. Focused Ion Beam (FIB) - Transmission Electron Microscopy (TEM) provides insight into the interface between the crystalline MOF and the amorphous particles (Fig. 1 F). Notably, Nanobeam Electron Diffraction (NBED) identifies unique diffraction patterns at the interface that do not correspond with the MOF`s crystalline structure, highlighting the complexity of this system. Furthermore, we utilize Correlative Atomic Force Microscopy with Scanning Electron Microscopy (AFM-SEM) to achieve high-resolution topographic imaging of the particles fused to the crystal (Fig. 1 G-I). The analysis reveals that the amorphous particles heights of approximately 0.1 nm, which are 38 times the unit cell dimensions. The edges seem to be higher than the center of the flower, suggesting accelerated growth and attachment at the edges of the flower structure.3 This study not only advances our understanding of MOF formation but also showcases the power of integrating multiple microscopy techniques to elucidate structural andinterface characteristics.

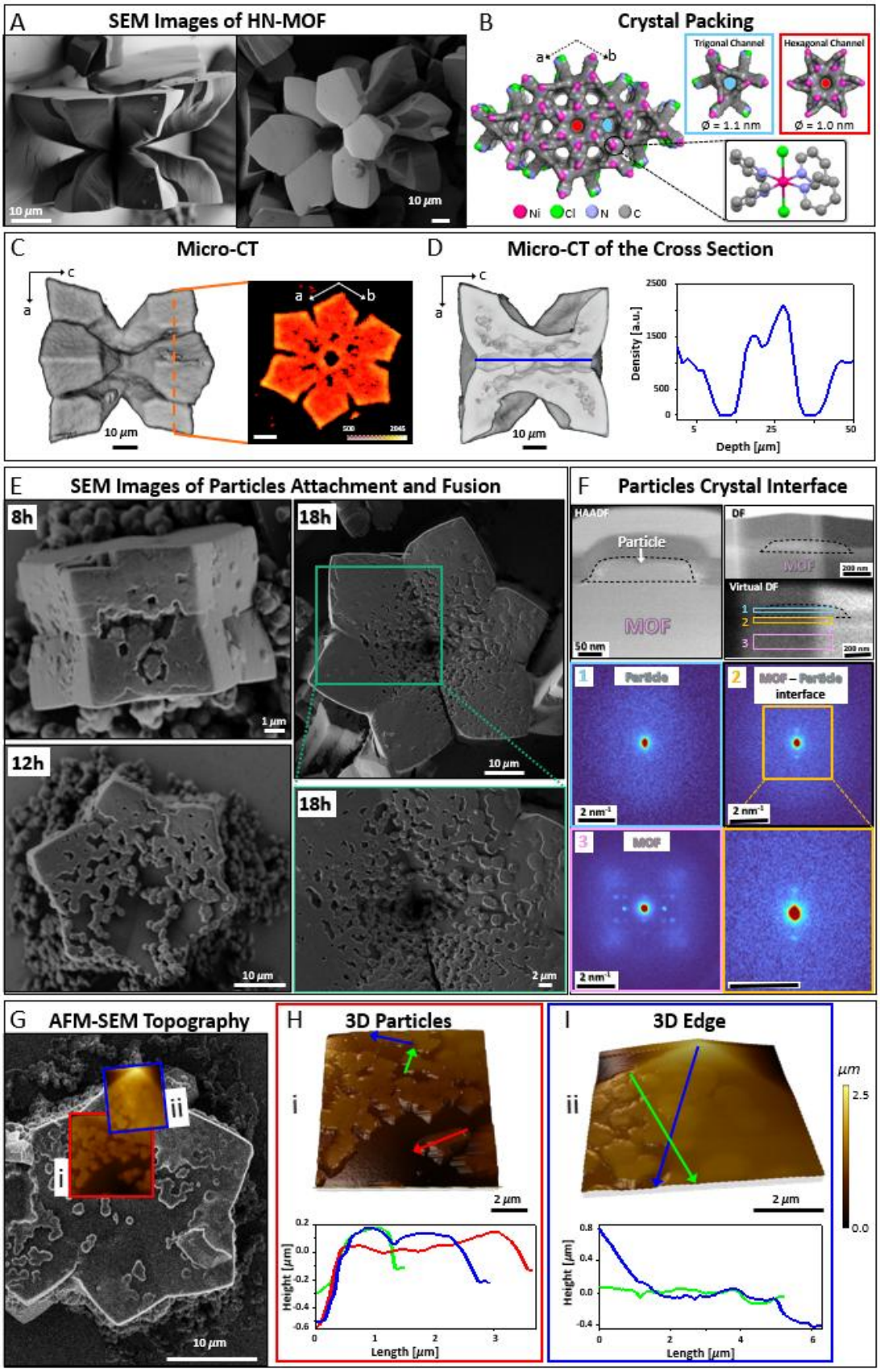


Fig 1. Characterization of HN-MOF growth process. A) SEM images of HN-MOF after 48h reaction time. B) Crystal packing of HN-MOF (voids ~ 37.5%). Bottom right inset shows the metal coordination center, top right inset shows the hexagonal (red) and triangular (blue) channels. C,D) Micro-CT data. E) SEM images of intermediate HN-MOF achieved at 8-18h reaction time showing

particle attachment and fusion mechanisms of growth. F) FIB-TEM lamella showing the particle-MOF interface (top). Nanobeam electron diffraction (NBED) data of surface-bound particle, MOF-particle interface, MOF (bottom). G) Correlative AFM- SEM topographic imaging of HN-MOF at 18h reaction. H,I) 3D recombination of areas i and ii and selected height profiles.

References:

1. H. Nasi et al., Size asymmetry in multidomain single crystals and the development of 312 curved surfaces. Cryst. Growth Des. 24, 8468–8475 (2024).

2. M. K. Corpinot, D.-K. Bučar, A practical guide to the design of molecular crystals. Cryst. Growth Des. 19, 1426–1453 (2019).

3. C. Rodriguez-Navarro et al., Direct nanoscale imaging reveals the growth of calcite 332 crystals via amorphous nanoparticles. Cryst. Growth Des. 16, 1850–1860 (2016).

PARALLEL SESSIONS II: Materials Science (Thursday, May 14, 2026, 16:00)

MORPHOLOGY-ACTIVATED SECOND-HARMONIC GENERATION IN METASTABLE PARA-RED PLATE CRYSTALS

Alon Krause[1], Adi Salomon[1]
Chemistry, Bar Ilan University, Ramat Gan, Israel

Organic molecular crystals offer high optical nonlinearity, yet their application is frequently hindered by the thermodynamic drive toward energetically stable but non-functional forms. In this work, we utilize Para-Red as a model system to demonstrate how growth conditions can override these thermodynamic preferences. While Para-Red is historically considered optically inert due to its thermodynamically favored needle-like growth habit which masks the polar axis , we successfully stabilized a distinct 2D plate-like morphology using vapor deposition at 180-230°C. Single-crystal X-ray diffraction confirmed that both the stable needles and our vapor-deposited plates belong to the same non-centrosymmetricspace group. This reveals that the material`s inactivity is not a fundamental structural limitation, but a morphological one defined by facet stability. By kinetically stabilizing the plate morphology, we exposed the active plane parallel to the molecular layers, granting direct optical access to the hyperpolarizability axis. Consequently, these plates exhibit strong Second Harmonic Generation (SHG), effectively "switching on" latent nonlinearity that is forbidden in the equilibrium needle form.

(a) (b)

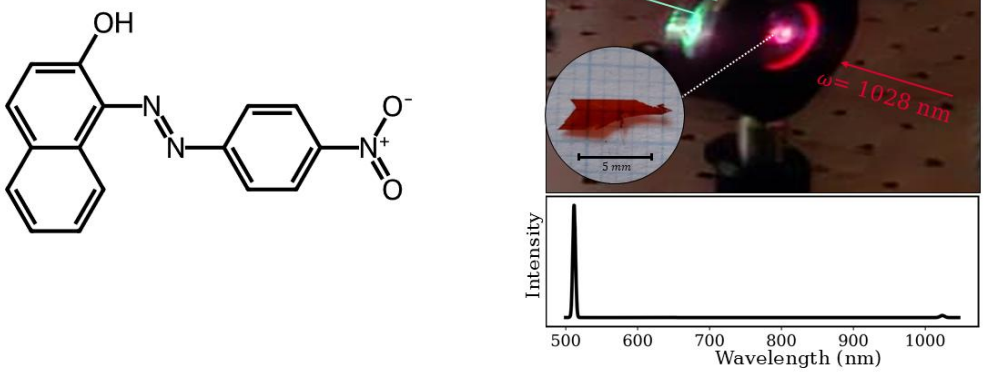


Figure: Para-Red as an optically active material (a) Para-Red molecule, possessing electron donor (OH) and acceptor (NO2) groups inducing high polarizability. (b) A plate crystal in a laser setup; an
incoming 1028 nm IR beam produces green 514 nm SHG. The optical spectrum shows a sharp SHG
peak at 514 nm and a small remnant of the 1028 nm signal.

PARALLEL SESSIONS II: Materials Science (Thursday, May 14, 2026, 16:00)

OPTICAL SENSORS FOR PROBING HYDROGELS AND THE BIOLOGICAL ENVIRONMENT

Shirel Kleiner[1], Verena Wulf[1], Gili Bisker[1,2,3,4,5]
[1]*School of Biomedical Engineering, Tel Aviv University, Tel Aviv, Israel*
[2]*Center for Physics and Chemistry of Living Systems, Tel Aviv University, Tel Aviv, Israel*
[3]*Center for Nanoscience and Nanotechnology, Tel Aviv University, Tel Aviv, Israel*
[4]*Center for Light-Matter Interaction, Tel Aviv University, Tel Aviv, Israel*
[5]*Sagol School of Neuroscience, Tel Aviv University, Tel Aviv, Israel*

Fluorescence sensors are often used for their high selectivity and sensitivity. However, their performance is often limited by autofluorescence and photobleaching, which reduce sensitivity, compromise reliability, and limit long-term observations. Single-walled carbon nanotubes (SWCNTs) have emerged as a promising solution. SWCNTs fluoresce in the near-infrared (NIR) range, which coincides with the biological transparency window, thereby minimizing autofluorescence interference, providing a higher signal-to-noise ratio, and enabling noninvasive sensing. Additionally, SWCNTs do not photobleach, rendering them suitable for continuous long-term sensing.

Hydrogels are versatile materials widely used in various biomedical applications. Characterizing hydrogels according to their application is important. Many methods of characterization are destructive, can be used for short periods, and are performed in vitro. Therefore, there's a need for a characterization method that monitors dynamic processes long-term, noninvasively, and in situ. To address this, we introduce a platform for real-time, noninvasive characterization of hydrogels utilizing SWCNTs as optical sensors and fluorescent tracers.[1] We focused on Fmoc-amino acid hydrogels.

First, we used transmission electron microscopy (TEM) to confirm that Fmoc-amino acids maintain their ability to form a fibrous network after suspension with SWCNTs (Figure 1A). We then tracked the self-assembly and disassembly of the hydrogels spectroscopically, by monitoring near-infrared fluorescence modulation. We used NIR fluorescence imaging to perform single-particle tracking of SWCNTs within the hydrogels. We observed either no change in the mean displacement of the SWCNTs, indicating non-restrictive mobility (Figure 1B), or a decrease, suggesting a more confined environment (Figure 1D). To correlate SWCNT mobility with hydrogel morphology, we imaged the hydrogels using scanning electron microscopy (SEM) (Figure 1C, E). The images revealed distinct structures, suggesting that the behavior of the integrated SWCNTs could indicate morphological differences in the hydrogel.

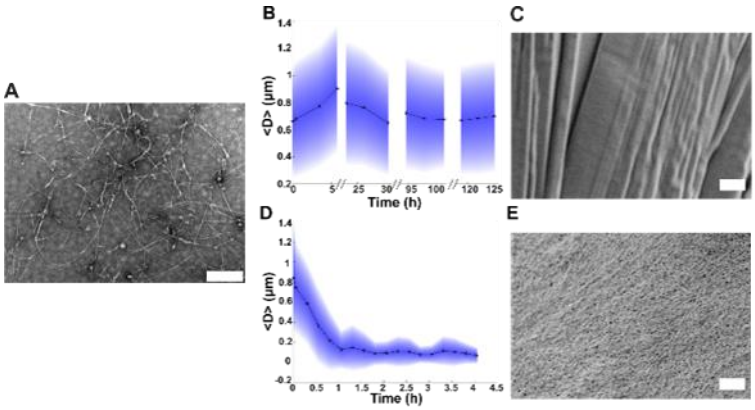


Figure 1. (A) TEM image of SWCNTs suspended with Fmoc-Trp. Scale bar: 200 nm. Mean displacement of SWCNTs in Fmoc-Phe (B) and Fmoc-Trp (D) hydrogels. SEM images of Fmoc-Phe (C) and Fmoc-Trp (E) hydrogels. Scale bar: 500 nm.

This work outlined a transformative approach to the continuous, non-destructive monitoring of hydrogels, shedding light on subtle changes in their microenvironment, as reflected in the fluorescence of SWCNTs. We expanded on this work to explore new methods for probing the biological environment by developing a minimally invasive carrier for SWCNT-based sensors that enables localized, site-specific, continuous measurement of drug concentrations using injectable hydrogels.[2]

Optimizing treatment plans for patients based on an individual's drug concentration can significantly improve therapeutic outcomes, as drug efficacy is closely linked to plasma levels. Therefore, developing precise tools for measuring drug concentration in situ is essential. We focused on levodopa, the primary treatment for Parkinson's disease.

Using NIR spectroscopy, we measured the levodopa-induced fluorescence response of a library of functionalized SWCNTs we generated, and selected one that showed the greatest increase in fluorescence (Figure 2A). To enable future in vivo application of SWCNT-based sensors, a matrix capable of encapsulating and transporting them is required. We therefore incorporated SWCNTs into an injectable hydrogel matrix for minimally invasive implantation. To confirm successful incorporation and spatial distribution of the SWCNTs within the injectable hydrogels, we used NIR fluorescence microscopy to capture their fluorescence and overlaid it on a bright-field image of the hydrogels (Figure 2B). The SWCNTs appeared dispersed and closely associated with the fibrous network. To assess the platform's functionality, we injected the composite hydrogels into a tissue-mimicking phantom that simulates the mechanical properties and optical scattering of the subcutaneous layer. Upon exposure to increasing drug concentrations, the SWCNTs exhibited a dose-dependent increase in fluorescence (Figure 2C), demonstrating the potential of this platform for localized drug monitoring.

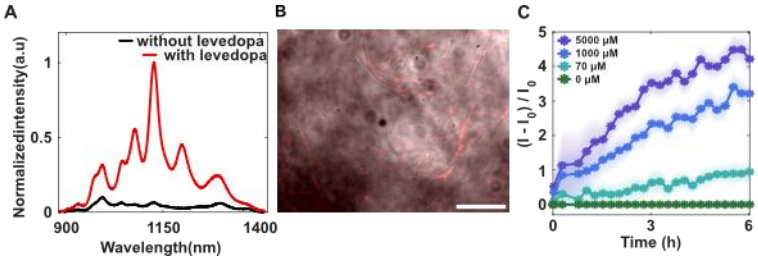


Figure 2. (A) Fluorescence intensity of SWCNTs before (black line) and after (red line) levodopa addition. (B) NIR SWCNT fluorescence overlay (red) with a brightfield image of the hydrogel

(gray). Scale bar: 20 µm. (C) Fluorescence response of SWCNTs to levedopa within the hydrogels injected into a phantom.

These results establish injectable hydrogels as a new class of function-preserving materials for the localized deployment of SWCNT sensors. Beyond levodopa, the approach can be extended to a wide range of drugs and clinically relevant biomarkers.

References

1 Kleiner, S. et al. J. Colloid Interface Sci. 670, 439–448 (2024)

2 Kleiner, S. et al. bioRxiv (2025)

PARALLEL SESSIONS II: Materials Science (Thursday, May 14, 2026, 16:00)

ELECTROSPUN PLLA COMPOSITE FIBERS WITH rGO AND MXene: SURFACE CHARGE MODULATION AND OSTEOBLAST RESPONSE

Martyna Polak[1,2], Piotr K. Szewczyk[1], Krzysztof Berniak[1], Urszula Stachewicz[1]
[1]*Faculty of Metals Engineering and Industrial Computer Science, AGH University of Krakow, Al. A. Mickiewicza 30, Kraków 30-059, Poland*
[2]*Faculty of Mechanical Engineering, Technion – Israel Institute of Technology, Haifa 3200003, Israel*

The interaction between biomaterials and cells is largely governed by surface properties, including charge distribution, which plays a key role in modulating cellular responses. However, control over surface charge in electrospun scaffolds remains underexplored. Poly(L-lactic acid) (PLLA) is a widely used biodegradable polymer for tissue engineering scaffolds, yet its natural piezoelectricity provides only limited electrical activity, which can be further enhanced by conductive nanofillers. Incorporation of two-dimensional (2D) conductive nanomaterials, such as reduced graphene oxide (rGO) and titanium carbide MXene ($Ti_3C_2T_x$), into electrospun PLLA fibers offers a promising strategy to engineer surface potential and enhance bioactivity.
In this study, composite PLLA scaffolds incorporating rGO and MXene were fabricated via electrospinning. Scanning electron microscopy (SEM) was employed to evaluate fiber diameter, morphology, and nanofiller distribution within the polymer matrix. Atomic force microscopy (AFM) combined with Kelvin probe force microscopy (KPFM) was used to map surface topography and quantify changes in surface potential introduced by the conductive additives. Confocal laser scanning microscopy (CLSM) enabled visualization of MG-63 osteoblast attachment, spreading, and focal adhesion formation on the composite scaffolds.
SEM analysis confirmed the formation of fibers, showing bead-like structures for composite formulations, with nanofillers embedded in the fiber structure. KPFM measurements revealed significant modulation of surface potential in rGO- and MXene-containing scaffolds compared to pristine PLLA, with MXene incorporation producing the most pronounced enhancement. This surface charge modulation significantly influenced MG-63 osteoblast focal adhesion point formation, as confirmed by CLSM [1, 2].

This work highlights that rGO and MXene can serve as functional nanofillers for engineering electrospun scaffolds with tunable surface electrical properties. The multi-scale microscopy approach, combining SEM, AFM/KPFM, and CLSM imaging, provides complementary insight into how nanofiller incorporation simultaneously modifies fiber morphology, surface charge, and the resulting cellular response. These results support the development of electrically active composite scaffolds for tissue engineering applications.

References

[1] Polak M., Berniak K., Szewczyk P.K., Karbowniczek J.E., Marzec M.M., Stachewicz U. PLLA scaffolds with controlled surface potential and piezoelectricity for enhancing cell adhesion in tissue engineering. Applied Surface Science, 2023, 621, 156835. https://doi.org/10.1016/j.apsusc.2023.156835
[2] Polak M., Berniak K., Szewczyk P.K., Knapczyk-Korczak J., Marzec M.M., Purbayanto M.A.K., Jastrzębska A.M., Stachewicz U. Modulating cell adhesion and infiltration in advanced scaffold

designs based on PLLA fibers with rGO and MXene ($Ti_3C_2T_x$). Materials Today Bio, 2025, 32, 101785. https://doi.org/10.1016/j.mtbio.2025.101785

Acknowledgements
This study was conducted with funding from the OPUS17 project grant provided by the National Science Centre in Poland (No2019/33/B/ST5/01311). This work was also supported by the BioCom4SavEn project funded by the European Research Council under the European Union's Horizon 2020 Framework Programme for Research and Innovation (ERC grant agreement no. 948840) and by the program 'Excellence Initiative – Research University' for the AGH University of Krakow in Poland. M.P. acknowledges support from Assist. Prof. Leeya Engel's Bio-Microsystems Lab at the Technion – Israel Institute of Technology.

PARALLEL SESSIONS II: Materials Science (Thursday, May 14, 2026, 16:00)

MECHANISM GUIDED CRYSTAL GROWTH: FROM MOLECULAR MECHANISIMS TO MATURE CRYSTALS WITH DESIGNED MORPHOLOGIES

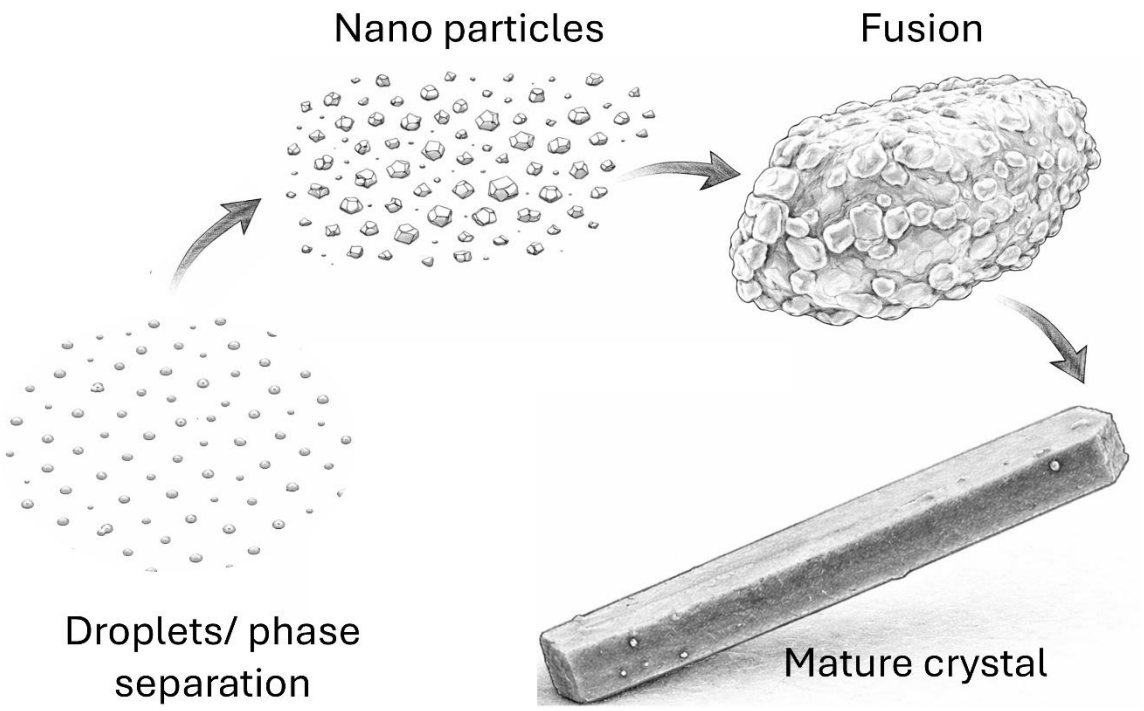
Snir Yosef, Ariel Klyuch, Ofri Aharon, Sourajit Bera, Ruth Aizen, Davide Levy, George Levi, Michael Gozin, **Angelica Elkan**[1,3]
[1]*Materials Science and Engineering, Tel Aviv University, Tel Aviv*
[3]*Jan Koum Center for Nanoscience and Nanotechnology, Tel Aviv University, Tel Aviv*

One of the major challenges in organic crystalline materials is translating molecular-level understanding of crystal growth mechanisms into the rational design of crystals with targeted properties. We demonstrate that by elucidating growth mechanisms and kinetics, crystallization pathways can be deliberately manipulated to achieve predictive control over crystal geometry, structure, and function.

Previously, we studied birefringent theophylline crystals and showed that driving crystallization into the classical growth mode, where crystals grow molecule-by-molecule via two-dimensional nucleation and layer spreading, enables precise control over crystal structure, shape, and dimensions. By tailoring growth conditions, we achieved polymorph selectivity among neat and hydrated forms and directed morphology toward either one-dimensional needle-like crystals or two-dimensional.

Currently, we extend these insights to morphology-sensitive energetic materials, focusing on hexanitrostilbene (HNS), a highly thermostable compound widely used in aerospace and deep-well applications. Conventional synthesis produces irregular needle- or plate-like crystals that increase mechanical sensitivity and hinder processing. Creating a safety challenge. In contrast, our mechanistically guided, surfactant-free crystallization strategy enables the reproducible formation of dense, spherical HNS particles with narrow size distribution, minimal aggregation, and preserved phase purity. Multimodal characterization (optical microscopy, SEM, AFM, TEM, and XRD) confirms their structural integrity and morphological uniformity.

Together, these results envision a general and transferable framework for rational crystal engineering, demonstrating that mechanistic insight into nucleation and growth enables precise, predictive control over crystal morphology in functional materials.


Nano particles
Fusion
Droplets/ phase separation
Mature crystal

INDEX BY TOPIC

01. Life Sciences

02. Materials Science

CATHODOLUMINESCENCE ENHANCEMENT MECHANISMS IN SILICA MICROSPHERES

OPERANDO SCANNING ELECTRON MICROSCOPY STUDY OF NICKEL FOAM CATALYST DURING AMMONIA DECOMPOSITION REACTION

CRYSTAL STRUCTURE METROLOGY USING SCANNING TRANSMISSION ELECTRON MICROSCOPY

INTERACTIONS OF AMPHIPHILIC INTERPOLYELECTROLYTE COMPLEXES WITH LIPOSOME MEMBRANES STUDIED BY ON-THE-GRID PROCESSING CRYO-TRANSMISSION ELECTRON MICROSCOPY

OVERLAY METROLOGY CHALLENGES IN ADVANCED SEMICONDUCTOR NODES

DAMSELFLIES OVERCOME COLOR SATURATION BARRIERS OF PHOTONIC GLASSES VIA PIGMENT LOADING AND REFRACTIVE INDEX MODULATION

CORRELATIVE IMAGING CAPTURES A FUSION MECHANISM AS THE ORIGIN OF SINGLE-CRYSTALS WITH MULTIDOMAIN APPEARANCE

MORPHOLOGY-ACTIVATED SECOND-HARMONIC GENERATION IN METASTABLE PARA-RED PLATE CRYSTALS

OPTICAL SENSORS FOR PROBING HYDROGELS AND THE BIOLOGICAL ENVIRONMENT

ELECTROSPUN PLLA COMPOSITE FIBERS WITH rGO AND MXene: SURFACE CHARGE MODULATION AND OSTEOBLAST RESPONSE

MECHANISM GUIDED CRYSTAL GROWTH: FROM MOLECULAR MECHANISIMS TO MATURE CRYSTALS WITH DESIGNED MORPHOLOGIES

03. Frontiers in Instrumentation **and methods:**

4D-STEM OF 2D MATERIALS AT LOW ELECTRON ENERGIES

Margulis: UNSUPERVISED MACHINE LEARNING AND 4D-STEM FOR ELUCIDATING HIDDEN STRUCTURAL DISORDER IN NANOMETER SCALES

PHYSICS-INFORMED SELF-SUPERVISED GENERATIVE MODEL FOR 3D LOCALIZATION MICROSCOPY

E+: SOFTWARE FOR HIERARCHICAL MODELING OF ELECTRON SCATTERING FROM COMPLEX STRUCTURES

TOWARDS A COMPACT SUB-100-MEV SEM ELECTRON SPECTROMETER

SUPER-RESOLVED INTEGRATED CRYO-FLUORESCENCE IMAGING ON LAMELLA FOR PRECISION CRYO-ET

ENABLING NON-INVASIVE, MULTIPLEXED, LONG-TERM OBSERVATION OF CELLULAR PROCESSES VIA LABEL-FREE LIVE IMAGING AND IN SILICO LABELING

Thursday, May 14, 2026

13:00 - 14:00 POSTER PRESENTATIONS, Posters Area

P-01 - P-41& 70: Life Sciences

P-42 - P-61: Materials Science

P-62 - P-69: Frontiers in Instrumentation and Methods

Abstracts

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

01. Life Sciences

P-1

RIBOSOME–COPPER INTERACTIONS IN CRYO-EM: GRID-DERIVED ARTIFACTS AND IMPLICATIONS FOR METAL HOMEOSTASIS

Aliza Fedorenko[1], Andre Rivalta[1], Anat Bashan[1], Jiro Kondo[2], Pascal Auffinger[3], Ada Yonath[1]

[1]*Chemical and Structural Biology, Weizmann Institute of Science, Rehovot, Israel*
[2]*Department of Materials and Life Sciences, Sophia University, Tokyo, Japan*
[3]*Université de Strasbourg, Strasbourg, France*

Cryo-electron microscopy (cryo-EM) of ribosome-antibiotic complexes revealed previously unassigned electron densities throughout the ribosome, with one in particular contributing to the antibiotic binding pocket. These features, observed at 1.8–2.4 Å from nucleobase nitrogens, are inconsistent with canonical ribosomal cations (Mg^{2+}, K^{+}) and appear reproducibly across 20 deposited ribosome structures. Systematic surveys identified three classes of densities: nucleotide-associated “lone” sites, short base-pair bridges, and longer inter-nucleotide bridges, suggesting coordination by a noncanonical metal ion. A small portion of the densities appear in a similar manner next to protein residues as well. Based on geometry and precedent from nucleic acid-metal interactions, copper is hypothesized as the most likely candidate.

Inductively coupled plasma mass spectrometry (ICPMS) excluded copper contamination from ribosome preparations, buffers, or growth media, as well as copper leaching in massive amounts from the cryo-EM grids. Comparative cryo-EM experiments of Staphylococcus aureus ribosomes on copper versus gold grids revealed that the anomalous densities occur exclusively in the copper-grid datasets, supporting a model in which localized, beam-induced copper leaching drives ribosome-copper coordination. These results identify copper grids as a previously unrecognized source of structural artifacts in cryo-EM.

This talk will explore the copper densities, their characteristics, geometry, and their rate of appearance. Theoretical and previous experimental support will be presented along with new experimental data to

explain the origin of these densities in ribosome structures. Finally, the chemical, structural, and biological implications of this study will be discussed.

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

01. Life Sciences

P-2

INVESTIGATING GENE EXPRESSION RE-ESTABLISHMENT POST-MITOSIS AND THE ROLE OF NUCLEAR BODY ASSEMBLY IN REGULATING MRNA TRANSCRIPTION AND EXPORT

Alon Boocholez[1], Heba Zoubi[1], Shahar Hammer[1], Yaron Shav-Tal[1]
Faculty of Life Sciences, Bar-Ilan University, Ramat Gan, Israel

Gene expression must be re-established in the nucleus after every cell division, to reinstate transcription, RNA processing, and export. Also, nuclear bodies, such as nuclear speckles that contain many mRNA-processing factors, reassemble. Prior studies have demonstrated the gradual assembly of the nucleolus by the return of rRNA transcription and nucleolar proteins following mitosis. However, it is unknown whether the timing of return of the many factors reactivating mRNA transcription, splicing, and export into the nucleus follows a programmed return or whether this is a random occurrence. Our study investigates the re-entry of nuclear proteins essential for reinitiating gene expression in conjunction with the formation of nuclear speckles during early interphase. The time-frame of this flux of molecules into the newly forming nucleus is short, making it a challenge to follow temporally. We found that by targeting the nuclear pore complex it is possible to prolong the phase of nuclear entry of numerous RNA-binding proteins. Since many of these proteins concentrate in cytoplasmic granules that form during mitosis, we can use live-cell microscopy to follow their import dynamics after mitosis. We find that certain RBPs return in distinct waves and that their re-entry is tightly linked to nuclear speckle formation and the reactivation of gene expression. The absence of these processing factors in the nucleus led to impaired RNA splicing and export, which were restored upon the re-entry of these factors. We are examining the distinct import mechanisms employed to regulate the timing of protein entry into the nucleus. Altogether, this study suggests a regulated hierarchy of nuclear import that is required for proper mRNA processing and export.

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

01. Life Sciences

P-3

SWIFT NUCLEAR TRANSPORT AND EXPORT OF HSP MRNAS DURING HEAT SHOCK IN LIVING CELLS

Mohammad Khaled Atrash[1], Andrew S. Belmont, Andrew S. Belmont[2], Yaron Shav-Tal, Yaron Shav-Tal[1]

[1]*The Mina and Everard Goodman Faculty of Life Sciences, Bar-Ilan University, Ramat-Gan, Israel*

[2]*Department of Cell and Developmental Biology, University of Illinois at Urbana Champaign, Urbana Champaign, Illinois, USA*

RNA export through the nuclear pore complex (NPC) plays a key role in the gene expression pathway, facilitating the transport of mature mRNPs to the cytoplasm. Several studies have followed mRNPs diffusing through the nucleoplasm until reaching the NPC. RNP travel from the gene and in the nucleoplasm was found to be rather slow, in the order of tens of minutes, while the translocation through the NPC is very rapid, taking less than half a second. We set out to examine whether these dynamics are modified during stress, when fast cellular gene expression and translation are required. To this end, we tracked single mRNPs in single living cells under heat shock conditions. Polyadenylated RNAs can accumulate in the nucleus during heat shock, whereas the export of heat shock protein (HSP) mRNAs continues. Applying a cell system in which HSP mRNPs can be tracked in real-time using the MS2 mRNA-tagging approach, we could follow HSP gene activation. HSP transcriptional induction was very dramatic, peaking between 5-8 minutes after the heat shock, and the HSP transcripts rapidly translocated to the cytoplasm within ~8 minutes, compared to the reported 30-120 minutes under steady-state conditions. The movement of the HSP mRNPs in the nucleus was fast, and surprisingly, these transcripts appeared in the cytoplasm in bulk amounts rather than gradually. Knockdown experiments showed that factors regularly involved in RNA export were not necessary for HSP mRNA export during heat shock. However, abrogating the NXF1/TAP pathway induced massive accumulation of HSP mRNPs in the nucleus and prevented their export. This block was also observed when HSP transcripts were truncated to lack their NXF1 binding site. Altogether, we find that heat shock can cause changes to the way the nucleus provides mRNP transport, during which HSP mRNPs are immediately produced and rapidly exit the nucleus via a unique export pathway.

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

01. Life Sciences

P-4

ALTERED AUDITORY PERCEPTION IN AUTISM SPECTRUM DISORDER

Netta Baram[1], Anita Temnogorod[1], Tal Levi[1], Jennifer Resnik[1,2]
[1]*Life Sciences Department, Ben-Gurion University, Be'er Sheva, Israel*
[2]*The Zelman Center for Neuroscience, Ben-Gurion University, Be'er Sheva, Israel*

Auditory perceptual abnormalities are a defining sensory feature of autism spectrum disorder (ASD), yet the cortical mechanisms that give rise to these changes remain incompletely understood. Here, we combined in vivo two-photon calcium microscopy with behavioral analysis in mouse models of ASD to define how auditory cortical population activity is altered and how these alterations shape sound perception.

Using a genetically encoded calcium indicator, we performed single-cell–resolution imaging of neuronal populations in the auditory cortex of awake mice during presentation of sounds spanning a range of intensities. This approach enabled us to visualize spontaneous activity, sound-evoked responses, and adaptation dynamics at high spatial resolution within intact cortical networks, providing a direct window into the functional organization of cortical sound processing. We found that ASD mouse models exhibited marked alterations in spontaneous and evoked activity, together with abnormal auditory adaptation, relative to wild-type controls, revealing disrupted population coding of acoustic stimuli.

We next assessed the perceptual consequences of these neural alterations using a two-alternative forced-choice loudness discrimination task. ASD model mice were more likely than wild-type mice to classify intermediate-intensity noise (60 dB SPL), typically judged as “soft” by control animals, as “loud”. These findings demonstrate the power of two-photon microscopy to bridge cellular-resolution circuit dynamics with behavior and identify altered cortical population coding as a potential substrate for increased loudness perception in ASD.

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

01. Life Sciences

P-5

MINIMAL ESCRT-III MACHINERY FROM ASGARD ARCHAEA DRIVES VESICLE BUDDING

Dikla Nachmias[1], Tom Bitton[1,2], Anat Nativ-Roth[2], Alexander Upcher[2], Ran Zalk[2], Philipp Radler[3], Christa Schleper[3], Natalie Elia[1]

[1]*Life Sciences, Ben-Gurion University of the Negev, Beer Sheva 84105, Israel*

[2]*Ilse Katz Institute for Nanoscale Science and Technology, Ben Gurion University of the Negev, Beer Sheva, 84105, Israel*

[3]*Archaea Biology and Ecogenomics Unit, University of Vienna, Djerassiplatz 1030, Austria*

Asgard archaea represent the closest known prokaryotic relatives of eukaryotes and encode multiple eukaryotic signature proteins (ESPs), whose functions remain largely unexplored. Among these, the Endosomal Sorting Complex Required for Transport (ESCRT) machinery is highly conserved and mediates essential eukaryotic functions, including membrane remodeling. Here, we studied the minimal ESCRT-III system of Asgard archaea, which includes only two ESCRT-III proteins (CHMP1–3 and CHMP4–7) and the VPS4 ATPase. Because no molecular tools are currently available for archaea, we reconstituted these proteins in heterologous bacterial hosts. We show that the archaeal ESCRT-III proteins assemble into functional complexes capable of driving vesicle budding, a core ESCRT activity. Additionally, expression of one ESCRT-III protein influenced bacterial cell division, suggesting a secondary role in cytokinesis. These results indicate that the core functions of the ESCRT machinery—vesicle formation and cell division—were already present in Asgard archaea, providing insights into the evolutionary origin of eukaryotic cellular processes.

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

01. Life Sciences

P-6

THE ORIGIN OF LIFE: STRUCTURAL AND FUNCTIONAL INSIGHTS OF THE PROTORIBOSOME

Disha Gajanan Hiregange[1], Franklin John[1,2], Alla Falkovich[3], Roman Kamyshinsky[3], Tanaya Bose[1,4], Gil Fridkin[5], Ella Zimmerman[1], Anat Bashan[1], Ada Yonath[1]
[1]*Department of Chemical and Structural Biology, Weizmann Institute of Science, Rehovot, Israel*
[2]*Department of Chemistry, Sacred Heart College, Kochi, Kerala, India*
[3]*Department of Chemical Research Support, Weizmann Institute of Science, Rehovot, Israel*
[4]*Structural Biology & Bioinformatics, CSIR-Indian Institute of Chemical Biology, West Bengal, India*
[5]*Department of Organic Chemistry, Israel Institute for Biological Research, Rehovot, Israel*

Extensive studies have elucidated the mode of action of ribosomes, the universal and highly efficient cellular machines for protein synthesis. Based on our structural studies, we hypothesized that the origin of the ribosome lies in a universal, internal semi-symmetrical RNA pocket-like segment, termed by us the protoribosome (Agmon et al., 2003), which is still embedded within all contemporary ribosomes, as a vestige of the ancestral ribosomes and is capable of catalyzing peptide bond formation (Bose et al., 2022). While our recent biochemical evidence confirmed that primordial RNA constructs can indeed mediate peptide bond formation, the structural logic enabling this function remains poorly understood. In this follow-up study, we aimed to decipher the structural features of these active protoribosome constructs and determine whether pockets formed between or within them are structurally analogous to the contemporary ribosome peptidyl transfer center (PTC) region. By applying cryo-electron microscopy techniques and computational modeling, we aimed to determine the minimal spatial requirements and geometric constraints the protoribosome constructs must exhibit, in order to feature their protein-independent catalysis. Our findings demonstrate that indeed such pockets are formed and are not merely historical relics but a functional scaffold that allowed life to transition from a chaotic RNA world to an organized protein-based system. By defining the structural homology between these primordial mimics and the contemporary peptidyl transferase center (PTC), we provide a blueprint for the emergence of life's most critical catalytic machine.

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

01. Life Sciences

P-7

MITOCHONDRIAL AND CELLULAR REMODELING DURING *LEISHMANIA* METACYCLOGENESIS REVEALED BY ELECTRON MICROSCOPY

Eyar Doron[1], Noam Reuven Tauba[1], Irit Dahan[1], Iris Grossman-Haham[1]
Life Sciences, Ben-Gurion University of the Negev, Beer Sheva, Israel

Leishmania is a flagellated protozoan parasite transmitted between mammals by sandflies and causes leishmaniasis, a neglected tropical disease that causes severe skin or visceral lesions[1]. During its life cycle, *Leishmania* transitions from a proliferative procyclic form to a highly motile metacyclic form in response to nutrient deprivation. This process, known as metacyclogenesis, involves flagellar elongation and enhanced motility that support migration to the sandfly's proboscis and transmission to a mammalian host[2]. The molecular changes occurring in the flagella during the transformation from the procyclic to the metacyclic stage, which are responsible for enhanced motility, remain unclear[3]. To dissect the molecular mechanism underlying enhanced motility in the metacyclic stage, metacyclogenesis was induced in vitro by purine starvation, and flagella isolated from procyclic and metacyclic cells were compared. Preparations of metacyclic flagellar cytoskeleton displayed darker pellet coloration compared to procyclic flagellar cytoskeleton, dependent on hemin supplementation, suggesting the incorporation of heme-associated material. Elemental analysis via ICP-OES and EDS-TEM indicates increased levels of metals, such as Iron (Fe) and Zinc (Zn), within metacyclic flagella and subcellular granules. To investigate the structural basis of these changes, we utilized FIB-SEM to generate 3D reconstructions. These models highlight a transition to a morphology of a slender cell body and a marked increase in granule density during the procyclic-to-metacyclic transition. High-resolution TEM and cryo-electron tomography (cryo-ET) confirmed that the core flagellar machinery remains structurally conserved. Furthermore, proteomic profiling revealed a massive enrichment of proteins with mitochondrial and metal-binding functions, such as Ubiquinol-cytochrome-c reductase-like protein (enriched 7800x). Notably, fluorescence microscopy confirmed the physical exclusion of the intact mitochondrial organelle from the flagellum, suggesting a targeted enrichment of specific respiratory components. These observations point to nutrient-stress-driven modifications in flagellar composition and cellular ultrastructure that may enhance motility and transmission competence. Future work will focus on the spatial localization and live-cell tracking of metabolic candidates to elucidate their translocation dynamics, alongside a statistical analysis of organelle morphology, including stage-specific changes in shape and volume.

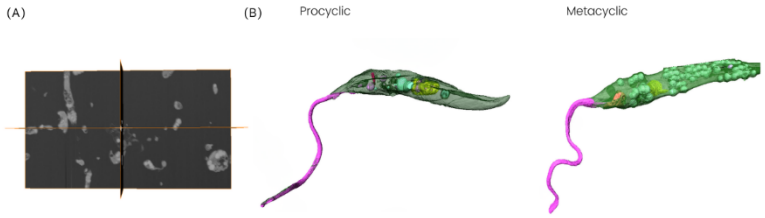


Fig. 1. 3D ultrastructure of *Leishmania* development. (A) Representative orthogonal slice from a FIB-SEM volume. (B) Procyclic vs. metacyclic models highlighting the transition to a slender morphology and increased granule density.

1. Torres-Guerrero, E., Quintanilla-Cedillo, M. R., Ruiz-Esmenjaud, J., & Arenas, R. (2017). Leishmaniasis: a review. F1000Research, 6, 750. https://doi.org/10.12688/f1000research.11120.1

2. Dostálová, A., Volf, P. *Leishmania* development in sand flies: parasite-vector interactions overview. Parasites Vectors 5, 276 (2012). https://doi.org/10.1186/1756-3305-5-276

3. Findlay, R. C., Osman, M., Spence, K. A., Kaye, P. M., Walrad, P. B., & Wilson, L. G. (2021). High-speed, three-dimensional imaging reveals chemotactic behaviour specific to human-infective *Leishmania* parasites. Elife, 10, e65051.

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

01. Life Sciences

P-8

INTEGRATING LIVE-CELL MICROSCOPY AND MACHINE LEARNING TO UNCOVER THE ROLES OF NON-CANONICAL MICROTUBULES BINDING OF KINESIN-5 MOTORS

Omer Bushusha[1], Karin Pliner[1], Neta Yanir[1], Mayan Sadan[1], Daniel Sevilla Sánchez[2], Leah Gheber[1,2]

[1]*Department of Chemistry, Ben-Gurion University of the Negev, Beer-Sheva, Israel*
[2]*Ilse Katz Institute for Nanoscale Science and Technology, Ben-Gurion University of the Negev, Beer-Sheva, Israel*

Kinesin-5 motor proteins play crucial roles in cell division by crosslinking and sliding antiparallel microtubules (MTs), thereby contributing to spindle-pole separation and mitotic spindle dynamics. Saccharomyces cerevisiae cells express two kinesin-5 homologs, Kip1 and Cin8, which share overlapping functions in dynamics, while Kip1 also performs distinct mitotic roles. Although Cin8 and Kip1 were thought to be exclusively plus-end directed, recent studies have shown that these motors exhibit bidirectional motility along MTs. These motors also share a distinct N-terminal non-motor domain (NTnmd) absent in exclusively plus-end-directed kinesins. To test the hypothesis that NTnmd regulates the functionality of bidirectional motors, we characterized Kip1 functions using in vitro and in vivo assays. For the in vivo analysis, S. cerevisiae cells expressing tdTomato-tagged spindle poles and either **WT or NTnmd-deleted Kip1** tagged with 3GFP, were imaged by live-cell fluorescence microscopy.

To enable efficient and unbiased image analysis, we developed a semi-automated, **machine-learning-based Spindle-Phenotype Characterization (SPC)** tool. This tool integrates deep learning-based segmentation algorithms (Cellpose) and morphological analysis (MorphoLibJ) to quantify intracellular phenotypes of S. cerevisiae cells from microscope images. The SPC tool allowed accurate classification of cells and spindle morphologies, motor localization, and precise measurement of spindle pole distance. The SPC tool produced reliable, expert-level measurements while significantly reducing analysis time and operator bias. Using SPC, we found that NTnmd-deleted Kip1 exhibited a diffusive spindle localization phenotype and prolonged early anaphase, indicating that the NTnmd-deleted Kip1 mutant exhibits reduced affinity for MTs, affecting mitotic spindle dynamics.

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

01. Life Sciences

P-9

THE EVOLUTIONARILY CONSERVED N' OF ESCRT-III PROTEINS FROM ASGARD ARCHAEA MEDIATES DNA BINDING, POLYMERIZATION AND MEMBRANE REMODELING

Shahar Grushka[1], Noam Guetta[1], Dikla Nachmias[1], Erez Zerbib[1], Alexander Upcher[1], Ran Zalk[1], Gal Halbi[1], Anne Bernheim[1], Natalie Elia[1]
Life Scinces, Ben Gurion University of the Negev, Beer Sheva, Israel

The endosomal sorting complexes required for transport (ESCRT) machinery is a highly conserved membrane remodeling system that mediates membrane constriction and fission across all domains of life. ESCRTs play a key role in processes such as cell division, membrane repair, and vesicle formation. While ESCRT homologs in bacteria are considerably distant from the eukaryotic ESCRT system, Asgard archaea encode ESCRT components that closely resemble those of eukaryotes, providing a unique opportunity to investigate the evolutionary origins of this membrane remodeling machinery.

Using in vitro reconstitution, we recently showed that recombinant Asgard ESCRT-III proteins CHMP4-7 self-assembles into helical filaments that form tubular structures. The presence of CHMP1-3 significantly modulates filament architecture by altering tube diameter and promoting more uniform assemblies. In addition, single-stranded DNA strongly enhances polymerization. Cryo-EM structural analysis revealed that the N-terminus of CHMP4-7 faces the interior of the tube, positioning it ideally to interact with nucleic acids and membranes. Incubation of ESCRT-III proteins with negatively charged small unilamelar vesicles (SUVs) resulted in the formation of long ESCRT-III tubes wrapping the membrane. When DNA and membranes were present simultaneously, ESCRT-III tubes were no longer observed. Instead, membrane necks and bridge- like structure were detected, with electron density localized at the neck region, suggesting ESCRT organization at sites of membrane constriction.

To test the role of the N-terminus in binding, we introduced mutations in the first 13 amino acids of the ESCRT-III proteins CHMP 4-7. Mutational analysis of the N-terminal region demonstrated that positively charged residues within the RKK patch are essential for DNA binding and filament assembly, whereas a conserved hydrophobic patch (LF) alters tube morphology. Despite these structural differences, both mutants retained the ability to remodel membranes. However, while the LF/AA CHMP 4-7 mutant exhibited enhanced ability to pull tubes from the membrane compared to WT CHMP 4-7, the RKK/AAA mutant lacked this capability.

Together, our findings provide mechanistic insight into how ESCRT-III proteins integrate interactions with nucleic acids and membranes through their N-terminal region, shedding light on the molecular principles that may have contributed to the emergence of early eukaryotic membrane remodeling systems.

POSTER PRESENTATIONS (Thursday, May 14, 2026 ,13:00)

01. Life Sciences

P-10

INVESTIGATING SPATIAL-TEMPORAL RNA-BINDING PROTEIN RECRUITMENT TO THE NASCENT TRANSCRIPT AND MRNP FORMATION

Hila Hamiel Levi[1,2], Yaron Shav-Tal[1,2]
[1]*The Goodman Faculty of Life Sciences, Bar-Ilan University, Ramat-Gan, Israel*
[2]*Institute of Nanotechnology and Advanced Materials, Bar-Ilan University, Ramat-Gan, Israel*

RNA plays a central role in gene expression, often as a ribonucleoprotein particle (RNP) complexed with RNA-binding proteins (RBPs). RBPs are critical for RNA maturation processes, including capping, splicing, polyadenylation, and export. However, our understanding of gene-specific mRNP assembly has been limited. Our objective is to investigate the temporal recruitment of RBPs to different regions of nascent transcripts at actively transcribing genes in living cells. Using fluorescently tagged RBPs and mRNAs in cell systems that allow the detection of active transcription sites, we have followed the recruitment of RNA Pol II to actively transcribing genes, alongside with RBPs that bind at the two ends of the transcript such as CBP80 and CPSF6. Live cell-imaging experiments showed a temporal delay of ~5 minutes from the recruitment of factors to the 5` and 3' ends. We observed that certain components of the TREX complex are robustly recruited to the transcription sites, while Exon-Junction Complex (EJC) subunits are notably absent. Furthermore, we identify TREX-associated factors that exhibit spatially restricted recruitment profiles regulated by the presence of downstream processing machinery. This research sheds light on the composition and dynamic assembly of mRNPs, linking RBP recruitment to transcriptional control of gene expression.

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

01. Life Sciences

P-11

WHOLE-BODY 3D STRUCTURAL AND CYTOSKELETAL CHARACTERIZATION OF HYDRA REGENERATION

Iris Pasvinter[1], Liora Garion[1], Kinneret Keren[1]
Physics, Technion - Israel Institute of Technology, Haifa, Israel

Hydra is a small freshwater animal with remarkable regenerative abilities, making it a powerful model for studying morphogenesis. During regeneration, the tissue undergoes dynamic remodeling, yet its 3D shape and cytoskeletal organization are not yet fully characterized. The actomyosin cytoskeleton forms supracellular fibers, which organize into parallel nematic arrays with a characteristic defect pattern. The defects coincide with sites of the emerging morphological features in the regenerating animal. Here, we use multi-view lightsheet microscopy, which provides long-term, high resolution 3D imaging, to follow regenerating Hydra expressing LifeAct-GFP. We developed an analysis pipeline to segment the tissue, follow its outer surface and lumen shape, and extract spatial maps of the tissue shape and thickness as well as the actomyosin fiber organization. Based on the nematic fiber pattern, we can define a tissue frame of reference and follow the morphological changes along the emerging body axis. We observe repeated cycles of osmotic lumen inflation at a constant rate, followed by abrupt deflation events. The volume of the surrounding tissue remains steady, enabling tissue thickness to serve as a coarse-grained measure of the isotropic tissue strain during regeneration. Using spherical harmonic decomposition of the shape and thickness fields, we quantify dynamic stretching modes and spatial correlations between tissue strain and the nematic organization of the actomyosin fibers. This framework allows us to study the interplay between large-scale morphological changes and the spatial organization of the actomyosin network and its impact on body plan formation.

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

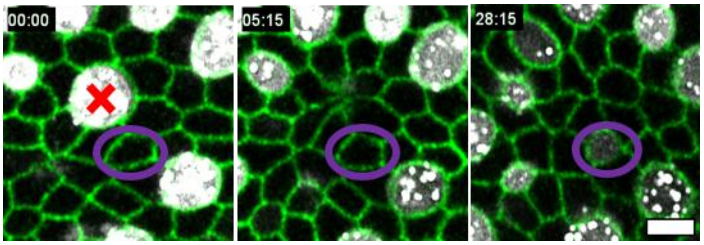
01. Life Sciences

P-12

MECHANICAL STRESS REGULATES LOCAL DIFFERENTIATION AND REGENERATION PATTERNS IN THE MAMMALIAN VESTIBULAR SYSTEM

Shahar Kasirer[1,2], Michal Shraga[1,2], Tim Dullweber[3], Olga Loza[1], David Sprinzak[1]
[1]*Biochemistry Department, School of Neurobiology, Biochemistry & Biophysics, Wise Faculty of Life Sciences, Tel Aviv University, Tel Aviv, Israel*
[2]*School of Physics and Astronomy, Exact Sciences Faculty, Tel Aviv University, Tel Aviv, Israel*
[3]*Biocentrum, Basel University, Basel, Switzerland*

In the vestibular system, lost hair cells (HC) can be regenerated by the trans-differentiation of nearby supporting cells (SC). For mammals, this regenerative capacity declines rapidly with age. In recent years, significant efforts have been made to develop regeneration promoting treatments, with encouraging, but limited success. It is known that HC differentiation is regulated by Notch-mediated lateral inhibition. In addition, recent studies indicate that mechanical stress might have a regulatory role during regeneration. However, it is yet unclear if regeneration is indeed regulated by mechanical forces, and if so, how it is coordinated with Notch mediated lateral inhibition. Here, we developed a live imaging assay for mouse utricle explants. In this assay we can monitor cell morphology and differentiation dynamics. Our results show unexpected age dependent deviations from the classical lateral inhibition model: While at earlier stages (E17.5) most differentiating HC do not have any HC neighbors, at more advanced age (P0) most HC differentiate next to existing HC. This is also for SC trans-differentiation in response to single HC ablation. To study the regulatory role of mechanical stress, we inhibit Rho-kinase, resulting in decreased mechanical stress (as measured by recoil laser ablation experiment) and eliminates the age dependent differences in differentiation dynamics. Relying on these results, we formulate a mathematical model of HC differentiation coupling lateral inhibition and mechanical stress. This model predicts correctly the observed differentiation patterns as well as the response to Rho-kinase inhibition, highlighting the regulatory role of mechanical stress in utricular HC differentiation and regeneration.



POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

01. Life Sciences

P-13

A NOVEL SYSTEMATIC COLLECTION OF YEAST STRAINS UNCOVERS CONSERVED KEY METABOLIC PROTEINS AS PEROXISOMAL RESIDENTS

Lior Peer[1], Nitya Aravindan[2], Jenny Keller[3], Eden Yifrach[1], Dekel Yahav Har-Shai[1], Rubén Fernández-Busnadiego[3], Doron Rapaport[2], Einat Zalckvar[4], Maya Schuldiner[1]
[1]*Weizmann Institute of Science, Rehovot, Israel*
[2]*Interfaculty Institute of Biochemistry, University of Tübingen, Tübingen, Germany*
[3]*Institute of Neuropathology, University Medical Center Göttingen, Göttingen, Germany*
[4]*The Mina and Everard Goodman Faculty of Life Sciences, Bar-Ilan University, Ramat-Gan, Israel*

Peroxisomes host a myriad of essential metabolic processes and are crucial for human health. Therefore, there is great significance in characterizing the complete peroxisomal proteome- the Peroxi-ome- as a basis for understanding peroxisomal functions. Our lab has been utilizing imaging-based fluorescent microscopy screens to identify additional peroxisomal proteins in yeast. In this work, we utilized a collection of strains representing the entire genome. In each strain, we expressed a single protein fused to the mNeonGreen fluorophore, alongside a peroxisomal marker. We imaged all strains to find cases of co-localization, uncovering 11 proteins never observed in peroxisomes. By utiziling high-resolution microscopy setup, we were able to identify their sub-peroxisomal localization. We found that seven are peroxisomal membrane proteins, all dually localize to peroxisomes and mitochondria. The other four are key metabolic enzymes, localized to the peroxisome periphery. Each of the four is known to form large filaments within the cell, which we observed moving together with peroxisomes, suggesting that they are physically tethered. Moreover, our data uncover a peroxisomal membrane protein as anchoring the vital and highly conserved enzyme Glutamine Synthetase.
Our work now investigates the function of the proteins we uncovered, enabling us to define a near-complete peroxi-ome in yeast, extending our knowledge regarding the functions of this highly versatile and fascinating organelle.

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

01. Life Sciences

P-14

DECIPHERING THE CYTOSKELETAL REGULATION OF MATRIX-PROTEIN TRAFFICKING DURING SEA URCHIN SKELETOGENESIS

Nirikshan Mandal[1], Tsvia Gildor[1], Smadar Ben-Tabou de-Leon[1]
Department of Marine Biology, University of Haifa, Haifa, Israel

Biomineralization is a common biological process in which organisms produce hard, mineralized structures essential for protection and support. Cells regulate mineral phase transitions through phylum-specific matrix proteins; however, when and where these proteins first co-localize with minerals and how they are trafficked to the biomineralization site remain unclear. In many systems, microtubule filaments serve as intracellular highways, guiding vesicular trafficking by motor proteins. Although microtubules are important for biomineralization across eukaryotes, little is known about their role in matrix protein trafficking.

To investigate the regulation of matrix-bearing vesicle trafficking, sea urchin larval skeletogenesis provides an excellent model system. The skeleton of a sea urchin larva is made of two calcite spicules generated by skeletogenic cells. Previous studies in fixed embryos have shown that matrix proteins are packed into vesicles at the Golgi, and their signal overlaps with microtubule filaments that extend to the spicule. We hypothesize that matrix bearing vesicles are actively transported along microtubules, in contrast to the actomyosin-mediated diffusive movement of mineral bearing vesicles. In this model, mineral and matrix proteins first meet at the biomineralization site.

To investigate the dynamics of matrix-bearing vesicles, we express fluorescently tagged matrix proteins, and track their dynamics in live embryos in control and under pharmacological perturbations of cytoskeletal components, using spinning-disk confocal microscopy. To study where the mineral and matrix-protein first co-localize, we label mineral-bearing vesicles with calcein within embryos expressing RFP tagged matrix-protein and use super-resolution imaging.

This study will uncover how the cytoskeletal machinery regulates the transport and deposition of matrix protein-bearing vesicles. Moreover, it will illuminate where and when mineral ions and matrix proteins first co-localize during biomineralization, shedding light on matrix proteins' role in regulating mineral phase transformation. Together, these findings will elucidate how intracellular transport mechanisms regulate biomineral growth.

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

01. Life Sciences

P-15

THREE-DIMENSIONAL MUSCLE ULTRASTRUCTURE IN FLIES AND MICE LACKING SARCALUMENIN EXPRESSION

Sergey Mursalimov[1], Ilan Zemski[1], Nechama Sasson[1], Eyal Schejter[2], Yael Alon[1], Ori Avinoam[1]

[1]*Department of Biomolecular Sciences, Weizmann Institute of Science, Rehovot, Israel*
[2]*Department of Molecular Genetics, Weizmann Institute of Science, Rehovot, Israel*

Muscle cells are highly organized multinucleated structures whose contractile function depends on the precise three-dimensional architecture of intracellular membrane systems, including the sarcoplasmic reticulum (SR), the mitochondrial network, and T-tubules. The spatial coordination of these structures is essential for excitation–contraction coupling and metabolic support of muscle activity, yet the molecular determinants governing their structural organization remain incompletely understood. Among these systems, the SR is particularly complex and highly dynamic, undergoing continuous membrane remodeling to support efficient muscle contraction, growth, and injury recovery across developmental stages and physiological states. The SR is a muscle-specific variant of the endoplasmic reticulum consisting of specialized subdomains essential for Ca^{2+} homeostasis, releasing Ca^{2+} to the cytosol for muscle contraction and reabsorbing it back to the SR lumen for relaxation.

Here, we use volume electron microscopy to analyze the three-dimensional ultrastructure of tissue in Drosophila larvae muscles and murine skeletal muscles both lacking sarcalumenin expression. Loss of sarcalumenin in Drosophila leads to a drastic reduction in the abundance of SR membranes in muscle tissue, accompanied by a pronounced simplification of their organization. In mice, sarcalumenin loss results in an inability of the SR to form proper tubular structures, with extended fenestrated SR sheets forming instead of the typical tubular network. In both flies and mice, loss of sarcalumenin is also accompanied by marked alterations in the mitochondrial network, characterized by increased complexity and abundance.

These findings support a model in which sarcalumenin shapes SR membrane architecture through intraluminal dynamin-like tubule formation and may advance understanding of SR dynamics during muscle contraction, development, and regeneration.

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

01. Life Sciences

P-16

PHYSICOCHEMICAL PROPERTIES OF MICROCALCIFICATION-MIMETIC CALCIUM PHOSPHATE NANOPARTICLES DICTATE CELLULAR UPTAKE AND CYTOTOXICITY IN BREAST CANCER CELLS

Yarden Nahmias[1], Gabriel Yazbek Grobman[1], Netta Vidavsky[1]
Chemical Engineering, Ben-Gurion University of the Negev, Beer Sheva, Israel

Pathological calcium phosphate (CaP) deposits known as microcalcifications (MCs) act as diagnostic biomarkers in breast cancer, with physicochemical properties correlated with disease invasiveness. These deposits range from nanometers to hundreds of micrometers within the tumor microenvironment. While CaP is mostly examined in scaffolds or coatings, cellular responses to unbound CaP dispersions, particularly nanoscale particles, remain overlooked. Although synthetic CaP nanoparticles (NPs) are widely studied for drug delivery, their properties differ substantially from pathological MCs, limiting insight into MC–tumor interactions.

We synthesized MC-mimetic CaP NPs from simulated body fluids, producing clinically relevant mineral variants, including carbonated apatite, amorphous CaP, and disordered magnesium/zinc-containing CaPs. Because zeta potential strongly influences cytotoxicity and cellular interactions, we examined its role in the interactions between MC-mimetic NPs and healthy, precancerous, and invasive human breast cancer cell lines, combining fluorescence and confocal microscopy, transmission electron microscopy (TEM) following ultramicrotomy, and cryo–soft X-ray tomography (cryo-SXT) to resolve uptake behavior, intracellular localization, and organelle associations.

Low NP colloidal stability caused by near-neutral or positive charge, together with needle-like rather than spherical morphology, enhanced cellular uptake and induced stronger cytotoxic effects, whereas composition and size played minor roles. Conditions promoting NP uptake also reduced lysosomal activity, decreased cell migration, and lowered spheroid formation. TEM revealed vesicular confinement of internalized NPs, while whole-cell cryo-SXT demonstrated that colloidally unstable particles were predominantly intracellular and associated with pronounced mitochondrial alterations, whereas highly negative, stable particles remained extracellular. Precancerous and cancerous cells showed significantly greater susceptibility to NP-induced death than healthy cells, attributed to increased NP internalization and altered lysosomal and mitochondrial pathways. These findings demonstrate that MC-mimetic CaP NP morphology and zeta potential modulate cellular behavior *in vitro*, suggesting these MC properties may critically influence whether cancer progresses or is inhibited *in vivo*.

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

01. Life Sciences

P-17

LS&E INFRASTRUCTURE CENTER: AN INTEGRATED MULTIMODALITY CORE FACILITY FOR STATE-OF-THE-ART MICROSCOPY IMAGING

Nitsan Dahan[1], Tally Chalolachvilli Mergener[1], Maayan Duvshani-Eshet[1]
The Life-Sciences and Engineering (LS&E) Infrastructure Center, Technion-Israel Institute of Technology, Haifa, Israel

The *LS&E microscopy unit* operates as an institutional core facility providing advanced imaging infrastructure, methodological expertise, and interdisciplinary scientific support to a broad research community. The facility functions as a knowledge-driven platform that assists investigators in translating biological and biomedical research questions into optimized imaging strategies.

Support begins at the experimental planning stage, where researchers are guided in refining scientific objectives, designing imaging workflows, and selecting the most suitable microscopy modalities according to sample type, spatial and temporal resolution requirements, and experimental constraints. The facility integrates multiple state-of-the-art imaging systems, including light-sheet microscopy, automated high-content screening, spinning-disk and laser-scanning confocal microscopes, multiphoton microscopy, and a multimodality super-resolution microscope (SIM, STED, and STORM). These imaging systems enabling visualization across biological scales—from whole small organisms and tissues down to subcellular structures and single-molecule resolution—applicable to both live and fixed specimens.

In addition to image acquisition services, the facility provides comprehensive image processing and quantitative analysis support. This includes data management, advanced image analysis, and the development of customized computational pipelines and tailored algorithms designed to address specific research needs. These capabilities allow researchers to extract robust quantitative information from complex imaging datasets.

As a core facility, the *LS&E microscopy unit* promotes standardized methodologies, efficient resource utilization, and technological accessibility while fostering interdisciplinary collaboration. By combining technological infrastructure with scientific consultation and analytical expertise, the center enhances experimental reproducibility, data quality, and research productivity across diverse scientific disciplines.

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

01. Life Sciences

P-18

INTERCELLULAR AND DUAL-SITE INHIBITION OF A BITTER TASTE GPCR

Nitsan Dallal[1]
Institute of Biochemistry, Food Science and Nutrition, The Hebrew University, Rehovot, Israel

Bitter taste receptors (TAS2Rs) belong to the large family of G protein coupled receptors (GPCRs) that sense chemically diverse molecules. TAS2R14 is one of the most broadly tuned receptors in this family, activated by over 385 ligands. It is expressed also extra-orally and is involved in processes related to immune defense, airway signaling, and cancer biology. CryoEM studies revealed that TAS2R14 contains not only the canonical extracellular binding pocket but also an intracellular binding site near the G protein interface. This raised the question whether receptor inhibition can occur through this lower pocket.

Several antagonists were previously discovered in our laboratory via structure-based virtual screening campaign using a model of the extracellular pocket. Now that the intracellular site was discovered, we set to unravel the actual interaction sites for the antagonists.

Using site-directed mutagenesis, IP One functional assays, and computational modeling, we found TAS2R14 antagonists that are sensitive mainly to mutations in the intracellular site, and are able to inhibit both TAS2R14 and TAS2R16, another bitter taste receptor. One TAS2R14 antagonist was found to be sensitive to mutations in both extracellular and intracellular pockets, and inhibited only TAS2R14. This finding, together with TAS2Rs sequence conservation analysis, suggests that intracellular binding site may provide a venue towards broader cross receptor inhibition.

AI-based ligand and receptor co-folding provided a structural explanation for the experimentally elucidated selectivity patterns, and can therefore guide future rational design of TAS2R inhibitors with defined receptor specificity, for both sensory and extra oral functions.

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

01. Life Sciences

P-19

INTEGRATED FABRICATION OF EM GRIDS FOR ACTIVE AND PASSIVE CELL MORPHOLOGY CONTROL

Noa Ben-Asher[1], Amit Avrahami[1], Leeya Engel[1]
Faculty of Mechanical Engineering, Technion - Israel Institution of Technology, Haifa, Israel

Cryogenic electron tomography (cryo-ET) is the highest resolution tool available today for structural analysis of macromolecular organization inside cells. Because cell morphology strongly influences intracellular architecture, controlling cell shape is critical for physiologically relevant studies. Here, we introduce a fully integrated, scalable process for batch fabrication of gold electron microscopy (EM) grids using standard semiconductor manufacturing tools commonly available in university cleanrooms. The resulting grids are compatible with both single-particle analysis and cellular cryo-ET. We demonstrate that these grids support maskless extracellular matrix (ECM) protein micropatterning, enabling precise control of cell shape directly on the grid surface. Furthermore, leveraging the versatility of our fabrication process, we created a new class of EM grids featuring anisotropic foils with oval holes, enabling passive alignment of cytoskeletal filaments without ECM micropatterning. This approach allows production of EM supports with tailored mesh and foil geometries, providing a route for large-scale fabrication of grids optimized for high-resolution imaging of cellular and molecular specimens.

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

01. Life Sciences

P-20

SYMMETRIC CANCER SPHEROID-FIBROBLAST 3D ORGANIZATION REVEALED AND CHARACTERIZED BY PSF-ENGINEERED HIGH-THROUGHPUT MICROSCOPY

Noam Zoref[1], Maytal Avrashami[1], Nadav Opatovski[2], Paul Keselman[3], Yosi Shamay[1], Yoav Shechtman[1,2,4]

[1]*Faculty of Biomedical Engineering, Technion - Israel Institute of Technology, Haifa, Israel*

[2]*Russell Berrie Nanotechnology Institute, Technion - Israel Institute of Technology, Haifa, Israel*

[3]*Sartorius Stedim North America Inc., NY, USA*

[4]*Faculty of Electrical and Computer Engineering, Technion - Israel Institute of Technology, Haifa, Israel*

High-throughput microscopy enables large-scale analysis of cancer spheroid interactions. Integrating this technique with point spread function (PSF) engineering, a customized optical modification of the imaging system, provides 3D imaging capabilities that enable volumetric analysis of the samples. However, existing methods for extracting volumetric information using this approach have been demonstrated primarily on point sources or have relied on supervised training data, limiting their general applicability to complex biological samples. Here, we reveal a unique, previously unreported spheroid-fibroblast interaction pattern using high-throughput microscopy. We further examine the interactions in 3D using a PSF-engineered high-throughput microscope, introducing unsupervised methods for 3D localization from single or dual image acquisitions. These methods enable 3D imaging with minimal phototoxicity and enhanced throughput and temporal resolution. Our approach reveals surprising spatial cellular trajectories in which fibroblasts self-organize into discrete clusters that distribute symmetrically around the spheroid surface in characteristic "flower-like" arrangements, and subsequently climb and penetrate the spheroid (Fig. 1). Additionally, our method enables rapid quantification and classification of drug responses that modulate these interaction patterns.

Fig. 1. 3D characterization of spheroid-fibroblast interaction patterns. (a) Fluorescence image of spheroid-fibroblast interaction pattern with 3D reconstructions (bottom and side views). The fibroblasts express green fluorescent protein (GFP). Scale bar: 100 µm. (b) Generation of the “flower-like” interaction pattern over time. Bottom row: Composite images combining a brightfield image and a green fluorescence image acquired using a PSF-engineered objective focused at the spheroid center, captured at various time points: 1, 2, 3, 5 and 16 hours. Top row: Corresponding 3D reconstructions. Scale bar: 100 µm.

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

01. Life Sciences

P-21

FUNCTIONAL ANALASIS OF THE N-TERMINAL REGION OF ASGARD CHMP4-7 REVEALS ITS ROLE IN DNA BINDING

Noy Goren[1], Dikla Nachmias[1], Noam Guetta[1], Natalie Elia[1]
Life Science, Ben-Gurion University of the Negev, Be'er Sheva, Israel

Among prokaryotes, the Asgard archaeal superphylum represents the most promising candidate for the evolutionary origin of eukaryotic cells. Members of this group encode eukaryotic signature proteins that may provide insights into the evolutionary origin of eukaryotes. The endosomal sorting complexes required for transport (ESCRT) are involved in cellular membrane remodeling. Its subcomplex, ESCRT-III, together with VPS4 (AAA-ATPase) forms the minimal machinery required for membrane remodeling. In our previous work, we showed that when ESCRT-III and VPS4 from Asgard archaea were co-expressed in mammalian cells, the ESCRT-III subunit CHMP4-7 localized to the nucleus. Moreover, we observed that CHMP4-7 can associate with DNA in vitro, a process shown to depend on its N-terminal region as demonstrated by an N-terminal deletion mutant lacking the first 13 amino acids. This mutation abolished the association with DNA. Here we aim to identify the residues that contribute to the nuclear localization observed for CHMP4-7 in mammalian cells. To this end, we examine the localization and interactions of a set of mutations within the N-terminal region of Asgard CHMP4-7 in mammalian cells. This study will provide insights into the evolutionary conservation of ESCRT-III's chromatin-binding properties and their potential role in the emergence of eukaryotic cellular organization.

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

01. Life Sciences

P-22

INVOLVEMENT OF ESCRT-III IN MICRONUCLEI

Noy Hanukayev[1], Dikla Nachmias[1], Venkata-Narasimha Kadali[2], Ofer Shoshani[2], Natalie Elia[1]

[1]*Department of Life Sciences, Ben-Gurion University of the Negev, Beer Sheva, Israel*
[2]*Department of Biomolecular Sciences, Weizmann Institute of Science, Rehovot, Israel*

Micronuclei are small extranuclear compartments, frequently abundant in cancer cells as a result of chromosomal missegregation or DNA damage. While the ESCRT-III complex is recognized for its central role in membrane remodeling and repair, its dynamic behavior in micronuclei in the context of cancer remains incompletely understood.

In this study, we employed HeLa cell models to systematically examine the recruitment of ESCRT-III subunits IST1 and CHMP1B to micronuclei induced by different protocols. Using high-resolution immunofluorescence analysis, we found enrichment of ESCRT-III proteins in approximately 20-40% of micronuclei. Notably, CHMP1B showed accumulation on micronuclei with reduced Lamin A/C signal, whereas IST1 was not detected on micronuclei with reduced Lamin A/C signal, suggesting distinct localization patterns for ESCRT-III subunits at different micronuclear states.

Our findings support a dynamic role for ESCRT-III proteins in micronuclei, independently of micronuclei origin, with implications for genome stability in cancer cells displaying micronucleation.

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

01. Life Sciences

P-23

SPATIAL MULTI-OMICS AND IMAGE ANALYSIS ILLUMINATE UNIQUE ZONATION PATTERNS AND DISEASE MECHANISMS

Ofra Golani[1], Oran Yakubovsky[2], Roy Novoselsky[2], Vishnu Mohan[2], Shiri Karagach[2], Tamar Gieger[2], Shalev Itzkovitz[2]

[1]*Department of Life Sciences Core Facilities, Weizmann Institute of Science, Rehovot, Israel, Israel*

[2]*Department of Molecular Cell Biology, Weizmann Institute of Science, Rehovot, Israel, Israel*

Spatial omics technologies provide deeper insights into cellular organizations and interactions within intact tissues, advancing our understanding of the design principles of tissues, their single-cell gene expression patterns and their disruption in pathological conditions.

In this presentation, we highlight three studies demonstrating the power of integrating multiple spatial omics modalities to generate novel biological insights. From the perspective of bioimage analysis, we emphasize the methodological challenges and solutions associated with spatially resolved multi-omics data. We show how integration in a spatial manner of imaging-based data with other modalities can give insights across multiple scales from tissue scale through anatomical regions and single cells to the subcellular level.

The first study (1) combines mass spectrometry-based proteomics with imaging-based immune and stromal profiling to investigate how the tumor microenvironment influences cancer cell plasticity and clinical outcomes in breast cancer. This integrative approach highlighted a dynamic interplay where low-grade tumors exhibit constrained immune infiltration, and upon progression, macrophages and T-cells infiltrate.

In the second study (2), we map gene expression in healthy human liver tissue using 10X Visium, Visium HD, MERFISH, and histological imaging. By segmenting high-lipid content regions from the histology images, and aggregating high-resolution transcriptomic data into low/high-content lipid expression profiles, we identified hepatocyte changes in steotosis.

In a third study (3), we apply high-resolution spatial transcriptomics (VisiumHD) to systematically resolve intracellular RNA distribution across diverse mammalian tissues. We introduce a computational approach that extracts subcellular features from spatial data and quantifies transcript localization patterns. For that we developed HiVis, an interactive platform that couples QuPath-based image segmentation and pixel classification with a flexible data-aggregation pipeline and Python library for end-to-end data exploration, visualization and analysis. Using this framework, we map apical-basal localization in gastrointestinal epithelia and in liver hepatocytes, and map nuclear retention of mRNAs in both mouse and human tissues.

Together, these three studies showcase the importance of spatially integrated multi-omics and advanced image analysis in resolving tissue complexity and understanding disease mechanisms.

References:

[1] Mardamshina, M.*, Karagach, S.*, Mohan, V. *, Arad G., Necula D., Golani O., Fellus-Alyagor L., Shenoy A., Krol K., Pirak D., Itzhacky N., Marin I., Shalmon B., Addadi Y., Sharan R., Gal-Yam E., Barshack I. & Geiger T. Integrated spatial proteomic analysis of breast cancer heterogeneity unravels

cancer cell phenotypic plasticity. Nat Commun 16, 10482 (2025). https://doi.org/10.1038/s41467-025-65477-6

[2] Yakubovsky, O., Afriat A., Egozi, A., Bahar Halpern, K., Barkai, T., Harnik, Y., Korem Kohanim, Y., Novoselsky, R., Golani, O., Goliand, I., Addadi, Y., Kedmi, M., Keren-Shaul, H., Fellus-Alyagor, L., Hirsch, D., Mayer, C., Peri, R., Pencovich, N., Timucin, T., Nachmany I & Itzkovitz S. A spatial transcriptomics atlas of live donors reveals unique zonation patterns in the healthy human liver. (2025), bioRxiv 2025.02.22.639181; doi: https://doi.org/10.1101/2025.02.22.639181

[3] Novoselsky, R.*, Golani O.*, Barkai T., Kedmi M., Goliand I., Fine M., Kent I., Nachmany I., Itzkovitz S. Subcellular mRNA localization patterns across tissues resolved with spatial transcriptomics. (2025). bioRxiv doi: https://doi.org/10.1101/2025.02.22.639181

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

01. Life Sciences

P-24

THE TECHNION CENTER FOR ELECTRON MICROSCOPY OF SOFT MATTER

Olga Kleinerman[1], Zipora Lansky[1], Ellina Kesselman[1]
Chemical Engineering, Technion, Haifa, Israel

The Technion Center for Electron Microscopy of Soft Matter (TCEMSM) has an expertise in direct imaging techniques of cryogenic-temperature transmission electron microscopy (cryo-TEM) and scanning electron microscopy (cryo-SEM) to characterize liquid systems, while preserving their nanostructure as close as possible to their native state. The systems under investigation in the Center include dispersions of nanoparticles in a variety of solvents, microemulsions, liposomal systems and complexes, and biological systems of cell components and processes. We implement cryo-TEM, cryo-STEM, cryo-Tomography, cryo-SEM and wide variety of cryo-specimen preparation techniques to support academic and industrial research in many fields locally and internationally, providing professional cryo-EM services.

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

01. Life Sciences

P-25

DEEP LEARNING BASED CORRECTION OF OPTICAL ABERRATIONS IN SINGLE MOLECULE LOCALIZATION MICROSCOY

Omer Gottlieb[1], Yoav Shechtman[1]
Biomedical Engineering, Technion - Isreal Institute of Technology, Haifa, Israel

Single molecule localization microscopy (SMLM) enables the visualization of cellular structures with resolution far surpassing the classical diffraction limit of light. In SMLM a fluorescence image is constructed from high-accuracy localization of individual fluorescent molecules that are switched on and off using light of different colors. Determining the exact axial (z) position of an emitter is challenging due to the near-symmetric nature of the point-spread function (PSF) around the focal plane. Beyond a certain depth of field (approximately 350 nm for high numerical aperture systems) the PSF rapidly defocuses, leading to a drop in signal-to-noise ratio leading to decline in localization precision. A method to extend the useful z-range and explicitly encode the z position is PSF engineering, where a phase mask is placed in the emission path of the microscope modifying the image formed on the detector. Even though a phase mask can accurately encode the emitter axial position, many biological applications require encoding of overlapping emitters which pose an algorithmic challenge due to the lateral overlap of their PSFs. To overcome this challenge deep learning methods were developed for accurate localization of emitters in SMLM samples. The effectiveness of these methods is highly susceptible to optical aberrations originating from imperfections in the optical components, refractive index mismatches within the sample that can distort the intended shape of the PSF, leading to inaccuracies in the estimated 3D positions of the emitters. This means that, practically, neural nets for 3D localization can only be trained after an imaging experiment has been done, so that a high-fidelity simulation can be compared to it. This training is a lengthy process that takes hours, limiting the usefulness of these analysis methods.

In this abstract, we address numerical post-acquisition correction of optical aberrations, using field-of-view (FOV)–dependent aberrations as a representative example. Such aberrations arise when light rays enter the optical system at varying angles across the FOV. We developed a deep learning model that was trained on simulated data and corrects optical aberrations in SMLM images. As a result, experimentally obtained images with aberrated PSFs can potentially be corrected to match with a pre-trained 3D localization network, alleviating the need for any post-experiment training.

Future work will extend FOV aberration correction to experiments with low Signal to Noise Ratio and additional sources of aberrations.

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

01. Life Sciences

P-26

α-SYNUCLEIN CONDENSATES AND INTERACTIONS IN CELLS USING ADVANCED FLUORESCENCE MICROSCOPY

Paz Drori[1], Yair Razvag[1], Joanna Zamel[1], Shalhevet Klemfner[2], Eran Meshorer[2], Nir Kalisman[1], Eitan Lerner[1]

[1]*The Alexander Silberman Institute for Life Sciences, The Hebrew University of Jerusalem, Jerusalem, Israel*

[2]*Department of Genetics, The Hebrew University of Jerusalem, Jerusalem, Israel*

α-Synuclein (α-syn) is an intrinsically disordered neuronal protein implicated in synaptic function and in neurodegenerative disorders such as Parkinson's disease. In addition to its well-established membrane interactions and self-association, α-syn has been proposed to undergo phase separation. Here, we present preliminary findings on α-syn condensates in SH-SY5Y cells. Imaging immunofluorescence of the endogenous protein revealed distinct cytoplasmic and nuclear puncta that do not colocalize with membranes, lipid droplets, or DNA-dense regions, consistent with membraneless condensates. Mass spectrometry identified candidate interactors linked to chaperone activity, proteostasis, and transcriptional regulation, while in situ crosslinking primarily detected α-syn self-interactions. Fluorescence lifetime imaging microscopy (FLIM) further suggested heterogeneity in condensate microenvironments.

Our current research focuses on elucidating α-syn cellular interactions using advanced microscopy approaches, including STED and a novel method developed in our laboratory—FRET-sensitized acceptor emission localization (FRETsael; DOI: 10.1016/j.bpj.2025.02.017)—to resolve interaction dynamics at high spatial precision. Together, these findings provide a foundation for understanding the formation and functional properties of α-syn condensates in cells.

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

01. Life Sciences

P-27

QUANTITATIVE LIVE IMAGING OF ACTOMYOSIN-DRIVEN MINERAL-BEARING VESICLE TRAFFICKING DURING BIOMINERALIZATION

Prashant Tewari[1], Tsvia Gildor[1], Smadar Ben Tabou de Leon[1]
Department of Marine Biology, University of Haifa, Haifa, Israel

Biomineralization, the process by which diverse organisms use minerals to harden their tissues, is fundamental to embryonic development and evolution yet its cellular basis remains poorly understood. Cells regulate mineral crystallization and skeletal architecture with precision far exceeding current technological capabilities, inspiring biomimetic design. In many species, mineral ions are transiently packaged in an amorphous form within intracellular vesicles and deposited into specialized biomineralization compartments to initiate skeletal growth. In other systems, vesicular trafficking is assisted by motor proteins that transport vesicles along actomyosin filaments toward focal adhesions. The actomyosin network is essential for biomineralization across eukaryotes, however, its specific role in guiding vesicular trafficking remains largely unknown.

Using the sea urchin larval calcite skeleton as a model, we combine spinning-disk confocal microscopy and computational vesicle tracking to quantitatively resolve vesicle dynamics in vivo. Our analyses reveal that mineral-bearing vesicles undergo active diffusive motion rather than directed transport. Vesicle diffusion length displays anticorrelation with actomyosin enrichment, suggesting that cytoskeletal organization constrains vesicle mobility. Strikingly, vesicle velocity decreases in proximity to the growing calcite spicule, indicating a localized capture or retention mechanism at the biomineralization compartment. We further detect focal adhesion components enriched around the spicule surface, suggesting that adhesion-mediated cytoskeletal remodelling may facilitate vesicle docking and mineral deposition. Pharmacological perturbation of actomyosin remodelling and adhesion components disrupt skeletal morphogenesis, supporting a functional role for cytoskeletal–adhesion coupling in regulating mineral delivery and deposition. Our ongoing quantitative analyses in embryos and skeletogenic cell cultures aim to define how cytoskeletal architecture and adhesion complexes regulate vesicle transport kinetics and mineral deposition. Together, this work establishes a quantitative live-imaging framework for dissecting the cellular mechanisms of biomineralization and provides mechanistic insight into how cytoskeletal organization governs mineral delivery during skeletal morphogenesis.

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

01. Life Sciences

P-28

MITOCHONDRIAL CONTROL OF PURINE FLUX SHAPES INTRACELLULAR GUANINE CRYSTAL FORMATION

Rachael Deis[1], Tali Lerer-Goldshtein[1], Katya Rechav[1], Neta Varsano[1], Avi Baram[1], Shifra Ben-Dor[1], Zohar Eyal[1], Meital Kupervaser[1], Ziv Porat[1], Dvir Gur[1]
Weizmann Institute of Science, Rehovot, Israel

Intracellular crystal formation depends on the coordinated integration of metabolic and energetic flux with specialized organelle function, yet how distinct organelles communicate to support this process remains poorly understood. In zebrafish iridophores, reflective guanine crystals assemble within membrane-bound organelles termed iridosomes, where tight regulation of purine availability is essential for defining crystal composition and morphology. Here, using in vivo light and fluorescence microscopy together with cryogenic electron microscopy, coupled with spectroscopy and biochemical analyses, we uncover a functional crosstalk between mitochondria and iridosomes that governs intracellular guanine crystal formation. Genetic and pharmacological perturbations of mitochondrial activity induce pronounced, quantifiable changes in crystal quantities, shape, and internal organization, visualized directly within intact cells and tissues. Importantly, these alterations do not reflect defects in crystal nucleation or growth, but instead arise from shifts in purine flux that increase hypoxanthine incorporation into the crystals.

Mechanistically, we identify a paralogue-specific requirement for the NAD^+-dependent enzyme Impdh1b in maintaining guanine-directed purine flux within iridophores. Disruption of mitochondrial function leads to NAD^+ depletion, triggering a coordinated rewiring of purine salvage pathway usage. This metabolic shift biases metabolite availability toward hypoxanthine, thereby reshaping crystal composition and subsequently, morphology within the iridosome.

Together, our findings establish mitochondria–iridosome communication as a key regulatory axis linking cellular metabolic state to intracellular material assembly. By integrating advanced cryogenic electron microscopy with live imaging and metabolic analyses, this work reveals how organelle crosstalk sculpts biogenic crystal growth under both physiological and metabolic stress conditions.

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

01. Life Sciences

P-29

MICROTUBULE INNER PROTEINS SHAPE THE BIOCHEMICAL LANDSCAPE OF CILIARY MICROTUBULES

Rachel Mary Clementina Joseph Raj[1], Shulamit Ben-Uliel[1], Mohammed Aboraya[1], Ron Orbach[1]

Azrieli Faculty of Medicine, Bar-Ilan University, Safed, Israel

Motile cilia and flagella are microtubule-based organelles essential for cellular motility and fluid movement across tissues. They contain a large network of microtubule-inner proteins (MIPs) that reside within the lumen of the microtubules forming the ciliary scaffold. Although dozens of MIPs have been identified, the functional significance of this extensive repertoire remains unclear.
To investigate the roles of MIPs in ciliary biology, we analyzed a set of MIP knockout mutants in the biflagellate green alga Chlamydomonas reinhardtii. We examined how loss of these proteins affects ciliary function, assembly and disassembly, structural organization, and biochemical properties.
While loss of MIPs does not produce major alterations in cell motility or the overall architecture of the ciliary scaffold, we found that specific MIPs influence the levels of microtubule post-translational modifications (PTMs), whereas others do not. These findings suggest that individual MIPs may contribute not only to the structural stability of the axoneme but also to shaping the PTM landscape of axonemal microtubules. These changes may affect PTM-dependent processes such as the ciliary trafficking system.
Together, our results provide new insight into why cilia contain such a large repertoire of MIPs and suggest that these proteins may differentially regulate the structural and biochemical properties of ciliary microtubules. Ongoing work further examines how changes in PTMs affect the ciliary trafficking system.

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

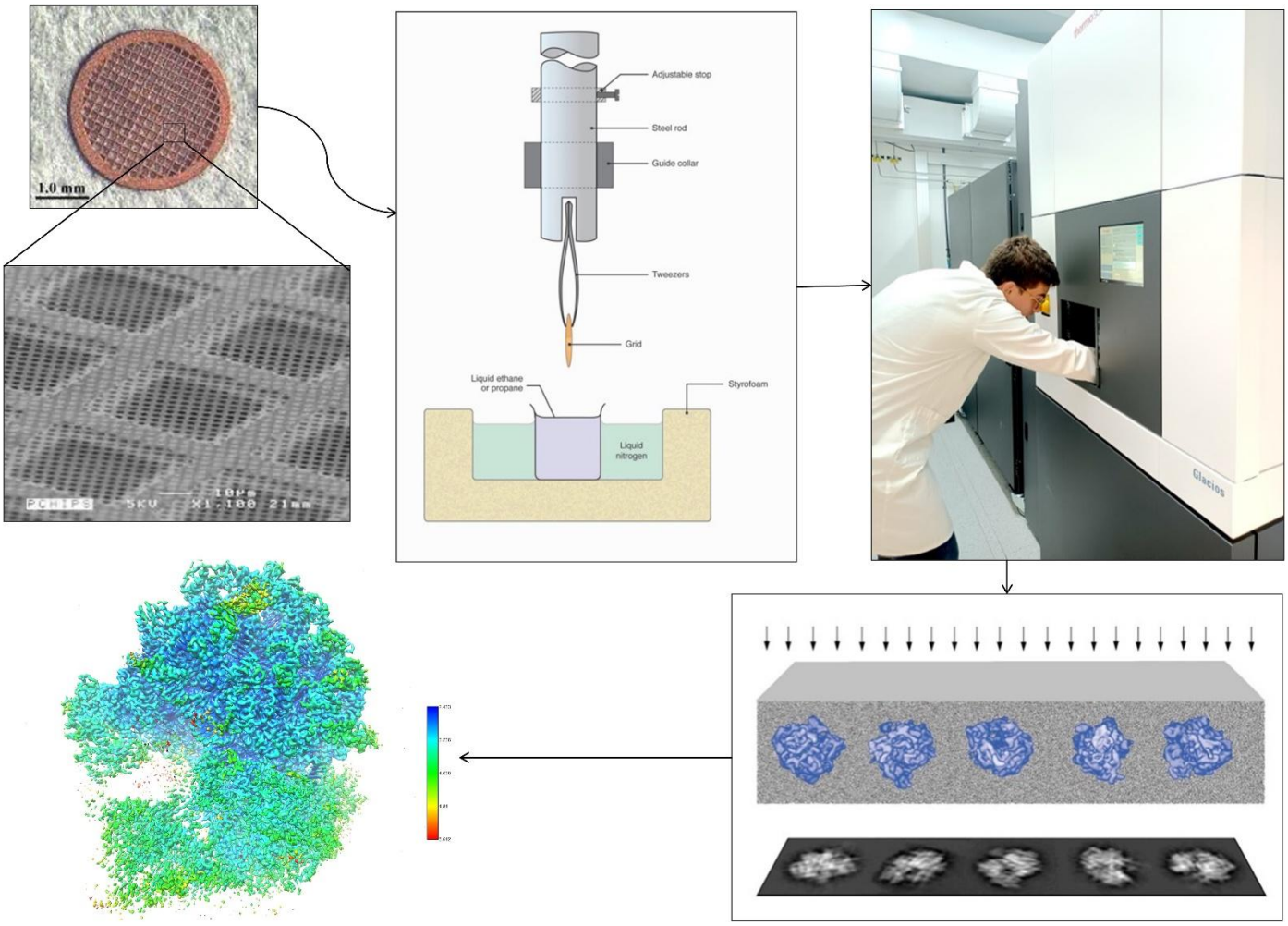
01. Life Sciences

P-30

CRYO-EM FOR BIOLOGICAL AND OTHER SOFT MATERIALS

Ran Zalk[1]
Ilse Katz Institute for Nanoscale Science & Technology, Ben-Gurion University of the Negev, Beer Sheva, Israel

Continuous developments in Cryo-electron microscopy (cryo-EM) have revolutionized macromolecular structure determination by enabling high-resolution visualization of biological materials in their close-to-native states. Our cryo-EM core facility at Ben-Gurion University, offers services to help elucidate high-resolution complex molecular architectures of biological and other soft-matter complexes. Our cryo-EM facility pipeline support sample preparation, data acquisition on a high-end microscope equipped with a state-of-the-art direct detector, image processing using advanced software packages, and high-performance computation for three-dimensional reconstruction. These capabilities already support researchers from Israeli academia and industry, across diverse disciplines to investigate the structures of proteins, nucleic acids, and organic complexes at unprecedented detail and accuracy. Our facility supports a wide range of projects, from basic research into cellular machinery to drug discovery initiatives targeting protein-drug interactions. Recent successes include elucidating the structures of challenging membrane proteins and large macromolecular assemblies, providing novel insights into their structures, functions and mechanisms of action. Furthermore, we encourage and support user training and collaborative partnerships within the university community and beyond. Through workshops, seminars, and one-on-one training sessions, we tarin young and experienced researchers to leverage cryo-EM as a tool for addressing fundamental biological questions and advancing scientific discovery.


1.0 mm
Adjustable stop
Steel rod
Guide collar
Tweezers
Grid
Liquid ethane or propane
Styrofoam
Liquid nitrogen

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

01. Life Sciences

P-31

THE STRUCTURAL AND DYNAMIC MECHANISMS OF THE TON MOTOR COMPLEX

Shahar LYUBINSKY[1], Shifra Lansky[1]
Department of Chemical and Structural Biology, The Weizmann Institute of Science, Rehovot, Israel

The Ton system is a proton-driven molecular motor that powers nutrient uptake in Gram-negative bacteria. It consists of an outer-membrane TonB-dependent transporter (TBDT) and an inner-membrane complex (ExbB–ExbD–TonB) that harvests the proton motive force (PMF) and transduces it to the TBDT. Although multiple studies have been conducted, the precise oligomeric organization of the inner-membrane subcomplex and the structural basis of its energy-transducing mechanism are still debated. To clarify these questions, we combine here single-particle cryogenic-electron microscopy (cryo-EM) structure determination with high-speed atomic force microscopy (HS-AFM) experiments. Using single-particle cryo-EM, we identified two different stoichiometries within the same purified protein sample. Specifically, we determined both a pentameric and a hexameric assembly of the ExbBD subcomplex to 3.4Å and 3.5 Å, respectively (Figure 1). The presence of two different assemblies within the same purified sample raises the question whether a dynamic equilibrium exists between the pentameric and hexameric states in the membrane, and whether such a dynamic equilibrium, or what we term oligomeric plasticity, could be an unexplored mechanism for ExbBD to modulate and regulate its function. To test this hypothesis, we use here HS-AFM to visualize directly, in real-time, on a sub-second time scale, the pentameric and hexameric states identified by cryo-EM while embedded in a membrane bilayer. Results from this project will advance our understanding of energy-driven nutrient transport mechanisms in E. coli, providing a structural basis for antibiotic development and informing us of the broader principles governing related proton-driven bacterial motors.

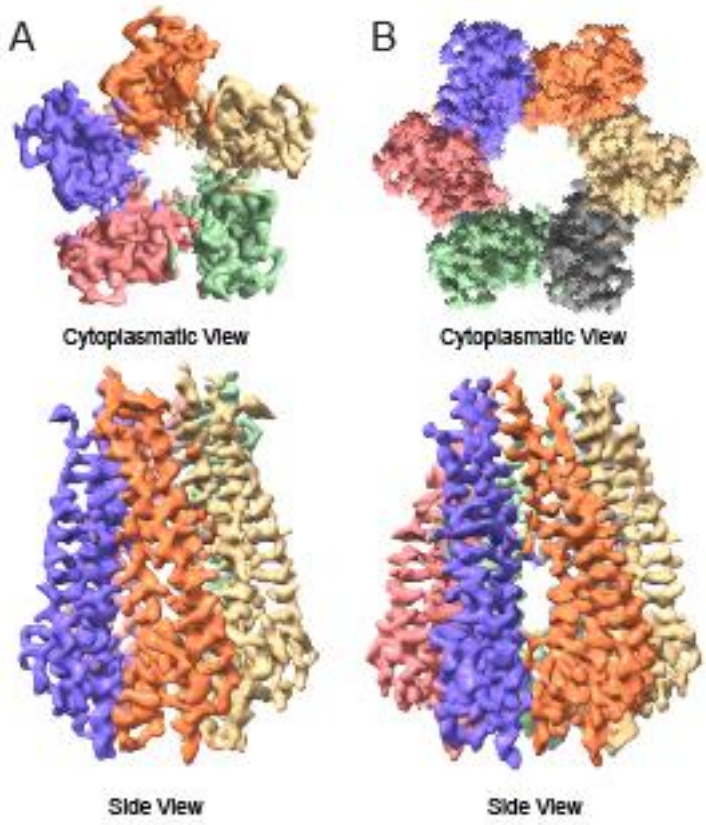


Figure 1 |Cryo-EM structures of the ExbBD hexameric and pentameric assemblies.
(A) Cryo-EM map showing cytoplasmic and side views of the ExbBD pentamer, determined to 3.5 Å resolution.
(B) Cryo-EM map showing cytoplasmic and side views of the ExbBD hexamer, determined to 3.4 Å resolution.

POSTER PRESENTATIONS (Thursday, May 14, 2026 ,13:00)

01. Life Sciences

P-32

TOMO4D: 4D-STEM TOMOGRAPIC RECONSTRUCTION

Shai Kiriati[1], Jose-Jesus Fernandez[2,3], Michael Elbaum[1]
[1]*Weizmann Institute of Science, Rehovot, Israel*
[2]*CINN-CSIC, Oviedo, Spain*
[3]*ISPA, Asturias, Spain*

4D-STEM records a 2D electron diffraction pattern using a pixelated electron detector, while scanning the electron probe in 2D across the specimen. Thus it captures the full diffraction pattern from each scan location. This technology has demonstrated uses in enhancing STEM image quality (Seifer, Elbaum 2024, Varnevides 2024) and has the potential to be used for quantitative analysis of the sample composition (Seifer, Houben 2024). 4D-STEM has further been adapted in our lab for cryo-tomography of biological specimens (Seifer, Elbaum 2024) However, conventional tomographic reconstruction addresses only a single measured intensity rather than a 2D array.

We have developed the Tomo4D pipeline to reconstruct a 2D diffraction pattern for each voxel (x,y,z) in the scanned sample. This provides depth resolution within the projected diffraction patterns. We demonstrate Tomo4D on a T4 Bacteriophage sample containing in addition gold nanoparticles for alignment, showing reconstructed diffraction patterns of both the disordered materials of the sample and the crystalline gold nanoparticles.

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

01. Life Sciences

P-33

CRYO-EM AND GRAPH REPRESENTATION REVEAL AN EVOLUTIONARILY CONSERVED ASSEMBLY PROGRAM IN PSEUDO-SYMMETRIC OLIGOMERS

Daniel Stein, **Shiran Dror**[1,2], Ran Zalk, Anat Sahar, Raz Zarivach, Gabriel A. Frank
[1]*National Institute for Biotechnology in the Negev, Beer Sheva*
[2]*National Institute for Biotechnology in the Negev, Beer Sheva, Israel*

How hetero-oligomeric structures are assembled and organized remains a central and unresolved question in structural biology. The problem becomes even more perplexing in pseudo-symmetric complexes with variable stoichiometries, such as ferritin nanocages, where two distinct subunits occupy symmetry-equivalent positions and compositional heterogeneity is masked by averaging.

Here, we combine cryo-EM and graph representation to resolve the assembly logic of a hetero-bacterioferritin nanocage. Analysis of the cryo-EM–derived atomic structure reveals two interface-encoded assembly constraints: a strict constraint that prevents heterodimer formation and a permissive constraint that favors heterotypic monomer–dimer interfaces. Representing the oligomer as a directed graph reveals how these local constraints propagate across the octahedral scaffold to shape global organization. Together, these experimentally resolved structural features reduce hundreds of thousands of theoretically possible arrangements to a small subset of preferred configurations.

The same interface determinants are conserved across related ferritins, indicating that the identified constraints are evolution-encoded features of this protein family. Importantly, this organizational program allows compositional flexibility while maintaining functional adjacency between specialized subunits, thereby conferring resistance to stochastic assembly noise.

To identify the oligomeric configurations contributing to the experimentally determined EM density map, we constructed an unbiased classifier by repurposing the Q-score as a feature-extraction scoring function and applying dimensionality reduction to enable objective classification of subunit identity. This analysis revealed that the ensemble of oligomer configurations is dominated by four arrangements consistent with the assembly rules.

This study demonstrates that integrating cryo-EM, a Q-score-based classifier, and graph modeling enables the extraction of hidden organizational rules from pseudo-symmetric oligomers, providing a general framework for resolving subunit organization in multimeric protein assemblies.

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

01. Life Sciences

P-34

THE EFFECT OF CARBON RESIDUE LENGTH ON GIANT UNILAMELLAR VESICLE MEMBRANE PERMEABILITY

Stav Yefet[1]
chemical engineering, Ben Gurion University, Gan Yavne, Isreal, Israel

Membrane permeability is a cornerstone of cellular bioenergetics, governing the generation of electrochemical gradients and material transport. While the solubility-diffusion model and Overton's rule suggest that lipophilicity dictates the passage of neutral molecules, a precise quantitative understanding of how structural variations—specifically alkyl chain length—modulate proton flux and transmembrane potential remains incomplete. We utilize an advanced microfluidic platform, Octanol-Assisted Liposome Assembly (OLA), to fabricate monodisperse, biocompatible Giant Unilamellar Vesicles (GUVs). To capture the rapid transport kinetics of weak acids, we employ a custom microfluidic chip designed for rapid external solution exchange. Proton permeation and the resulting transmembrane potential are quantified in real-time, allowing us to distinguish between the translocation of neutral species and ionic H^+. GUV detection, tracking, and lumen fluorescence intensity quantification are performed using custom-developed Python scripts. Our primary objective is to investigate how the hydrophobicity and steric factors of carboxylic acids, dictated by their carbon chain length, influence their permeability coefficients. Initial measurements established a baseline permeability coefficient for strong acids, with HCl exhibiting a permeability of 0.007 cm/s. Building on this reference, we are currently characterizing a series of weak carboxylic acids with varying alkyl chain lengths to measure the resulting electrochemical gradients and the development of the proton motive force (PMF). We anticipate that our approach will guide the development of protein based transport driven by proton gradient in artificial cell models and enable a deeper understanding of how vital acids, such as fatty acids, amino acids, bile acids, and carboxylic acid-containing drugs, traverse the lipid bilayer.

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

01. Life Sciences

P-35

UNRAVELLING THE MOLECULAR MECHANISMS OF BIOGENIC PURINE CRYSTALLIZATION IN YEAST

Sukanya Bera[1], Tali Leler Goldshtein[1], Zohar Eyal, Zohar Eyal[1], Sourabh Bera[1], Avi Baram[1], Orna Dahan[1], Iddo Pinkas[2], Dvir Gur*[1]

[1]*Department of Molecular Genetics, Weizmann Institute of Science, Rehovot, Israel*
[2]*Department of Chemical Research Support, Weizmann Institute of Science, Rehovot, Israel*

Purine biocrystallization is widely observed in unicellular eukaryotes[1-2], where it serves as a strategy for nitrogen storage and metabolic regulation, in contrast to multicellular organisms that utilize ordered purine crystals for vision, structural coloration, camouflage, communication, and thermoregulation[3-6]. Yeast represents an excellent eukaryotic model for investigating purine crystallization due to its experimental tractability and its ability to form crystals in response to fluctuations in nitrogen availability. This makes yeast a powerful platform for studying the interplay between nitrogen metabolism and crystal formation. Leveraging yeast`s experimental advantages to unravel the metabolic interplay underlying purine crystal formation driven by nitrogen availability. In this study, we establish *Kodamaea Ohmeri* (*K. Ohmeri*) as a model system to examine nitrogen source dependent purine biocrystallization. *K. Ohmeri* exhibits distinct intracellular crystal formation patterns depending on the available nitrogen source. Real-time crystal nucleation and growth dynamics were monitored using advanced light microscopy and live-cell imaging, enabling the quantitative analysis of crystallization kinetics. Biogenic crystals formed under different nitrogen conditions were characterized using HPLC, and Raman spectroscopy to determine their chemical compositions. Our findings reveal that β-guanine crystals form in the presence of ammonium sulfate, whereas hypoxanthine-rich conditions induce hypoxanthine crystal formation. This integrative approach provides mechanistic insight into how nitrogen availability governs purine metabolism and intracellular crystal nucleation, establishing *K. Ohmeri* as a powerful model for studying biogenic crystallization in unicellular systems. In the future, using ultrastructural analyses and molecular approaches, we will identify the key players and the subcellular sites of crystal formation, and assess their impact on organismal fitness as well as their broader implications for nitrogen ecology.

References:

1. Moudříková Š. et.al. (2017) Raman microscopy shows that nitrogen-rich cellular inclusions in microalgae are microcrystalline guanine. Algal Research. 23: 216–222.

2. Jantschkea A. et.al. (2019) Anhydrous β-guanine crystals in a marine dinoflagellate: Structure and suggested function. Journal of Structural Biology. 207: 12–20.

3. Gur D. et.al. (2020) In situ differentiation of iridophore crystallotypes underlies zebrafish stripe patterning. Nat. Commun. 11: 6391.

4. Gur, D. et. al. (2017) Light manipulation by guanine crystals in organisms: biogenic scatterers, mirrors, multilayer reflectors and photonic crystals. Advanced Functional Materials. 27.6: 1603514.

5. Kjernsmo K. et.al. (2020) Iridescence as Camouflage. Current Biology. 30: 551–555.

6. Kinoshita S. et.al. (2005) Structural colors in nature: the role of regularity and irregularity in the structure. Chemphyschem. 6: 1442-1459.

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

01. Life Sciences

P-36

ADAPTING ITERATIVE EXPANSION MICROSCOPY FOR FACILITY-BASED SUPER-RESOLUTION IMAGING SERVICES

Tom Biton[1,2], Dikla Nachmias[2], Ran Zalk[1], Marianna Zaretsky[2], Amir Aharoni[2], Alexsandra Tsitrin[1], Natalie Elia[2], Efrat Forti[1]

[1]*Ilse Katz Institute for Nanoscale Science and Technology, Ben-Gurion University of the Negev, Be'er-Sheva, Israel*

[2]*Faculty of Natural Sciences, Ben-Gurion University of the Negev, Be'er-Sheva, Israel*

Expansion Microscopy (ExM) enables nanoscale imaging on conventional light microscopes by physically enlarging biological specimens embedded within a swellable hydrogel. Since its introduction by Boyden and colleagues more than a decade ago, numerous ExM variants have been developed, achieving progressively higher expansion factors and improved preservation of ultrastructural detail. Despite its transformative potential, however, ExM has not yet been widely adopted across the broader biological research community.

Several factors contribute to this limited adoption. Existing protocols are highly diverse and often optimized for specific biological systems, requiring extensive tuning of fixation, anchoring, gelation, and denaturation steps. Differences between protocols can introduce expansion artifacts, structural distortion, or inconsistent label retention. In addition, the absence of standardized workflows or widely available "kit-based" solutions places a substantial technical burden on individual laboratories attempting to implement the method independently.

Here, we address these challenges by adapting iterative Expansion Microscopy workflows for implementation as a facility-based super-resolution imaging service. Centralizing technical development within a core imaging facility enables the establishment of standardized protocols, quality control procedures, and reproducible reagent preparation that can support a wide range of biological samples while minimizing the optimization burden for individual users.

Our current workflow is based on the Cryo-iU-ExM protocol developed by the Guichard group (University of Geneva), which combines cryo-fixation (high-pressure freezing or plunge freezing), freeze substitution, and an optimized denaturation step to preserve ultrastructural integrity during iterative expansion. The protocol is inherently modular and compatible with diverse sample types as well as downstream computational super-resolution approaches such as SRRF.

Using this framework, we have successfully implemented the workflow across multiple biological systems, including cultured HeLa cells, yeast, and chemically fixed murine brain tissue slices. In HeLa cells, the approach enables visualization of ESCRT-III organization at the cytokinetic abscission site, while yeast and tissue samples demonstrate the adaptability of the pipeline across distinct experimental models.

POSTER PRESENTATIONS (Thursday, May 14, 2026 ,13:00)

01. Life Sciences

P-37

QUANTITATIVE ANALYSIS OF CHROMATIN BIOPHYSICS REVEALS LAMIN A AS A KEY REGULATOR OF NUCLEAR ORGANIZATION

Wajdi Nicola[1], Vered Levi[2], Irina Bronshtein[1], Yuval Garini[1]
[1]*Biomedical Engineering, Technion, IIT, Haifa, Israel*
[2]*Physics Department& Instite of Nanotechnology, Bar Ilan University, Ramat Gan, Israel*

Tens of thousands of genes are compactly organized within the nucleus of eukaryotic cells. These genes are arranged along chromosomes, each occupying a distinct nuclear sub-volume known as a chromosome territory (CT). Chromatin - a complex of DNA and associated proteins - exhibits hierarchical spatial organization across multiple length scales while remaining dynamically active. Although chromatin organization is closely linked to essential cellular functions, the underlying mechanisms governing this organization, especially at the large length scales, remain incompletely understood. In our study, we investigate both the structural organization and dynamic behavior of nuclear content, and the impact of these processes on the proper nuclear function.

A central component contributing to chromosomal organization and chromatin dynamics is the nuclear lamina, a scaffold-like structure underlying the nuclear envelope and composed primarily of lamin proteins. Utilizing live-cell confocal microscopy imaging of chromatin elements, such as fluorescently labeled histones and telomeres, we examined the role of lamin A in regulating chromatin dynamics at the nuclear scale. By applying quantitative, image-based mapping approaches grounded in single particle tracking and cross-correlation analysis, we captured the spatiotemporal evolution of chromatin motion throughout the entire nucleus in living cells. Our results demonstrate that lamin A plays a critical role in constraining chromatin motion and preventing the emergence of disordered, chaotic dynamics. Further dynamic analysis highlighted the impact of the protein in controlling chromatin spatial correlation which seems to be related to regulating the interphase chromatin structure.

In addition, we investigated the structural impact of lamin A on chromosome territories using whole-chromosome fluorescence in situ hybridization (FISH). We detected significant alterations in CT volume and morphology in lamin A deficient cells compared to lamin A expressing controls. Together, our findings indicate that lamin A is essential for maintaining both the dynamic stability and structural integrity of chromosome territories within the nucleus.

The observed influence of lamin A on large-scale chromatin dynamics and structural organization has important functional implications for nuclear integrity. Using spectral karyotyping (SKY), a spectral imaging-based technique that assigns a distinct color to each mitotic chromosome to enable detection of chromosomal aberrations, we detected a significantly higher frequency of chromosomal abnormalities in lamin A deficient cells compared to control cells.

Based on our experimental findings, we propose a model in which lamin A functions as a chromatin cross-linking protein during interphase. In this model, lamin A binds chromatin, modulates its dynamics, preserves higher-order structural organization, enhances large-scale nuclear stability, and consequently reduces the incidence of chromosomal aberrations.

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

01. Life Sciences

P-38

TUMOR-SUPPRESSIVE ROLE OF CALCIUM OXALATE DIHYDRATE IN BREAST CANCER

Gabriel Yazbek Grobman[1], Yarden Nahmias[1], Shiran Dror[2], Liron Levin[2], Netta Vidavsky[1,2]

[1]*Department of Chemical Engineering, Ben-Gurion University of the Negev, Beer Sheva, Israel*

[2]*Ilse Katz Institute for Nanoscale Science and Technology, Ben-Gurion University of the Negev, Beer Sheva, Israel*

Crystals can form in the human body under both normal and pathological conditions. Among them, calcium oxalates (CaOx) are well-known for their role in kidney stones and as microcalcifications (MCs) in breast and thyroid cancers. Calcium oxalate monohydrate (COM) is typically associated with pathological outcomes in urolithiasis, whereas calcium oxalate dihydrate (COD) is predominantly linked to benign conditions, both in the kidney and in breast tissues.1,2 We recently demonstrated that COD crystals suppress breast precancer progression in vitro, suggesting a protective role.3,4

Here, we investigated how synthetic CaOx crystals of different hydration states, morphologies, and surface properties interact with breast cancer cells. High-resolution scanning electron microscopy (SEM) was used to characterize the crystals, revealing differences in morphology, particle size, and surface roughness among the various crystal types. Crystal–cell interactions and their effects on cell behavior were examined using light and fluorescence microscopy.

Our results revealed that the less negatively charged crystals exhibited a greater tendency to aggregate and, as aggregates, attached better to cells, particularly to the cells of an invasive breast cancer cell line. We did not find any association between crystallinity, surface area, and solubility of the crystals and attachment to cells. The crystal types that did attach efficiently to the cells, namely COD with a thin or thick bipyramidal morphology, had the greatest impact on cell phenotype and delayed cell growth, most probably through contact inhibition. Notably, in terms of morphology and size, these crystals resembled COD MCs found in benign breast tissues, suggesting that they are involved in a mechanism of tumor suppression.

Our findings highlight the importance of crystal–cell interactions in breast cancer and suggest that COD crystals are active participants in maintaining tissue homeostasis and suppressing tumor progression, and could potentially be used for therapeutic purposes.

References:

(1) Khan, S. R.; Canales, B. K.; Dominguez-Gutierrez, P. R. Randall's Plaque and Calcium Oxalate Stone Formation: Role for Immunity and Inflammation. Nat. Rev. Nephrol. 2021, 17 (6), 417–433.

(2) Frappart, L.; Boudeulle, M.; Boumendil, J.; Chi Lin, H.; Martinon, I.; Palayer, C.; Mallet-guy, Y.; Raudrant, D.; Bremond, Md.; Feroldi, J. Structure and Composition of Microcalcifications in Benign and Malignant Lesions of the Breast: Study by Light Microscopy, Transmission and Scanning Electron Microscopy, Microprobe Analysis, and X-Ray Diffraction. Hum. Pathol. 1984, 15 (9), 880–889.

(3) Cohen, A.; Gotnayer, L.; Gal, S.; Aranovich, D.; Vidavsky, N. Multicellular Spheroids Containing Synthetic Mineral Particles: An Advanced 3D Tumor Model System to Investigate Breast Precancer Malignancy Potential According to the Mineral Type. J. Mater. Chem. B 2023, 11 (33), 8033–8045.

(4) Yazbek Grobman, G.; Nahmias, Y.; Aranovich, D.; Sharabi, O.; Ofir, N.; Gazit, R.; Dror, S.; Levin, L.; Vidavsky, N. Calcium Oxalate Crystals with a Bipyramidal Morphology and a High Tendency to Aggregate Attach Directly to Breast Cancer Cells and Affect Their Phenotype. ACS Appl. Mater. Interfaces 2025, 17 (41).

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

01. Life Sciences

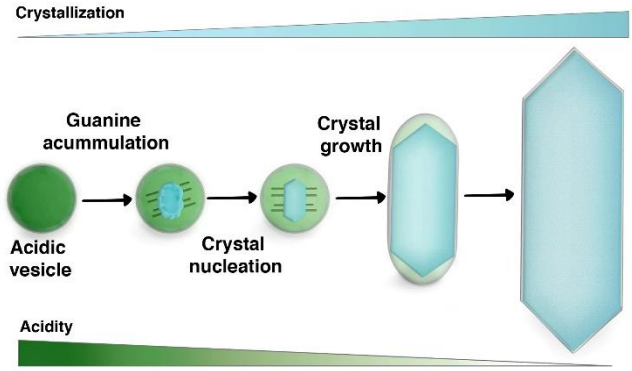
P-39

PH VARIATIONS ENABLE GUANINE CRYSTAL FORMATION WITHIN IRIDOSOMES

Zohar Eyal[1], Rachael Deis[1], Anna Gorelick-Ashkenazi[1], Yuval Barzilay[1], Yonatan Broder[1], Asher Perry Kellum[1], Neta Varsano[1], Michal Hartstein[1], Andrea Sorrentino[2], Ron Rotkopf[1], Ifat Kaplan-Ashiri[1], Katya Rechav[1], Rebecca Metzler[3], Lothar Houben[1], Leeor Kronik[1], Peter Rez[4], Dvir Gur[1]

[1]*Weizmann Institute of Science, Rehovot, Israel, Please Select, Israel*
[2]*Mistral Beamline, Alba Synchrotron Light Source, Cerdanyola Del Vallès, Spain*
[3]*Colgate University, Hamilton, New York, USA*
[4]*Arizona State University, Tempe, Arizona, USA*

Many animals produce vivid colors by reflecting and amplifying light with stacked guanine crystals within membrane-bound organelles called iridosomes. While the presence of guanine crystals in iridosomes is well documented, the mechanisms facilitating the accumulation of water-insoluble guanine and driving its crystallization remain unclear. Here we used cryo-electron microscopy, live-cell pH imaging, pharmacological perturbations and spectroscopy to study iridosome maturation in zebrafish. Cryo-electron and synchrotron-based soft X-ray microscopies revealed that amorphous guanine initially accumulates in early-stage iridosomes in its protonated state. Live-cell imaging with a pH sensor demonstrated that early iridosomes are acidic, with pH gradually neutralizing during development. Inhibiting V-ATPase disrupted this acidification and significantly reduced crystal formation, indicating its role in pH regulation. Our findings reveal insights into the molecular mechanisms facilitating guanine formation within iridosomes, emphasizing the pivotal role of pH alternations in the precise formation of biogenic crystals.



POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

01. Life Sciences

P-40

RECONSTITUTION OF THE PARAFLAGELLAR ROD SCAFFOLD IN KINETOPLASTID PARASITES

Shaked Ambar Cohn[1], Irit Dahan[1], Tom Biton[2], Iris Grossman Haham[1]
[1]*Department of Life Science, Ben Gurion University of the Negev, Beer Sheva, Israel*
[2]*The Ilse Katz Institute for Nanoscale Science and Technology, Ben Gurion University of the Negev, Beer Sheva, Israel*

Leishmania and Trypanosoma are Kinetoplastid parasites and the causative agents of leishmaniasis and African sleeping sickness1, respectively, diseases that together impact millions globally. Their flagellum is essential for parasite motility and disease transmission2: in Leishmania, it enables migration from the sand fly gut to the proboscis for host infection, while in Trypanosoma, it supports transmission by the tsetse fly and navigation within the mammalian bloodstream.

Unlike most eukaryotic organisms, these parasites harbor a unique structure in their flagella alongside the conserved axoneme, called the Paraflagellar Rod (PFR)3. The PFR is a massive protein complex which is essential for parasite motility, but its exact function is still not known4. While the PFR is made of dozens of proteins, PFR1 and PFR2 form the foundation of the structure, yet its overall organization is unclear. This study aims to define its structural framework.

Reconstitution of the PFR is being pursued using complementary in vitro and in vivo strategies. In L. mexicana (Leishmania mexicana) cells, Crosslinking of intact flagella, followed by mass spectrometry, enables mapping the interactions between PFR1 and PFR2, and the interactions that create PFR2 oligomers within the native flagellar environment. Recombinant L. mexicana and Trypanosoma brucei proteins were produced and purified. PFR2 forms stable higher-order oligomers, as confirmed by crosslinking and negative-stain TEM. GFP-tagged constructs revealed distinct oligomerization patterns: while PFR1 alone appeared diffuse, PFR2 formed punctate structures, and co-expression of PFR1 with PFR2 indicated direct interactions stabilizing higher-order assemblies. Expansion Microscopy of L. mexicana cell shows the distribution pattern of PFR1 and PFR2 in the flagellum. Beyond the primary PFR1-PFR2 scaffold, our efforts are also focused on evaluating the roles of calmodulin and myosin as potential structural anchors, using fluorescence microscopy and pulldown experiments.

Our findings demonstrate PFR2 oligomerization, PFR1- PFR2 interaction and introduce complementary approaches for dissecting PFR assembly. Together, they lay the groundwork for clarifying the molecular architecture of the PFR and its role in parasite motility.

1. World Health Organization. (2023). Leishmaniasis and Trypanosomiasis, African (sleeping sickness).

2. Bastin P, et al. The paraflagellar rod of Trypanosoma brucei is required for normal flagellar beat and cell motility. J Cell Sci. 1998.

3. Deflorin J, et al. The paraflagellar rod of Kinetoplastida: shared and specific components. J Biol Chem. 1994

4. Portman N, Gull K. The paraflagellar rod of kinetoplastid parasites: From structure to components and function. Int J Parasitol. 2010

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

02. Materials Science

P-41

IN SITU IMAGING OF NEMATOCYST RESPONSES TO POST-STING TREATMENTS

Carmel Danino Gozlan[1], Dror Angel[1]
Humanities, Applied Marine Biology and Ecology Research Laboratory, University of Haifa, Haifa, Israel

Nematocysts are specialized stinging organelles responsible for envenomation in cnidarians and are the primary cause of the jellyfish stings that we experience. Understanding how these organelles respond to externally applied materials is important for improving post-sting treatment strategies. In this study, we investigated the response of nematocysts (generally organized in batteries) in tentacles of the jellyfish *Rhopilema nomadica* to materials commonly used as first-aid treatments following jellyfish stings. The tested materials were selected based on a web-survey we conducted on jellyfish sting treatments and on scientific literature reports.

The experimental approach was based on the Tentacle Solution Assay commonly used to evaluate nematocyst discharge in response to applied solutions. In this study, the protocol was expanded to test additional topical materials, including creams and ointments. To examine potential neutralization effects, materials were first applied on intact tentacles, followed by application of acetic acid, a known inducer of nematocyst discharge that we used as a positive control. A material was considered to have a neutralizing effect if the addition of acetic acid did not induce discharge.

Using inverted light microscopy, materials were applied directly on tentacles to study their effects without the use of slide coverslips. Because topical applications may induce contraction or expansion of tentacles and alter focal planes, repeated refocusing was required to track the same battery. Z-stack acquisition allows observation of the same nematocyst battery at several focal planes, and image stitching (tiling) generates high-resolution images of extended tentacle regions, allowing qualitative assessment of discharge patterns.

This approach also enables in situ identification of the three main nematocyst types present in *R. nomadica* based on their morphological characteristics, allowing evaluation of differences in their responses to the applied materials.

Preliminary results indicate that aloe vera has a neutralizing effect. Further experiments are currently underway to confirm these findings. This microscopy-based approach may contribute to the evaluation of commonly used post-sting treatments and support the development of evidence-based first-aid recommendations for jellyfish stings.

Bibliography:

1. Avian, M., Spanier, E., & Galil, B. (1995). Nematocysts of *Rhopilema nomadica* (Scyphozoa: Rhizostomeae), an immigrant jellyfish in the Eastern Mediterranean. *Journal of Morphology*, 224(2), 221-231.

2. Ballesteros, A., Marambio, M., Fuentes, V., Narda, M., Santín, A., & Gili, J. M. (2021). Differing effects of vinegar on *Pelagia noctiluca* (Cnidaria: Scyphozoa) and *Carybdea marsupialis* (Cnidaria: Cubozoa) stings—Implications for first-aid protocols. *Toxins*, 13(8), 509.

3. Edelist, D., Angel, D. L., Barkan, N., Danino-Gozlan, C., Palanker, A., Barak, L., & Bentur, Y. (2023). Jellyfish sting web-survey: clinical characteristics and management of *Rhopilema nomadica* envenomation in the Mediterranean Sea. *Regional Environmental* Change, 23(3), 114.

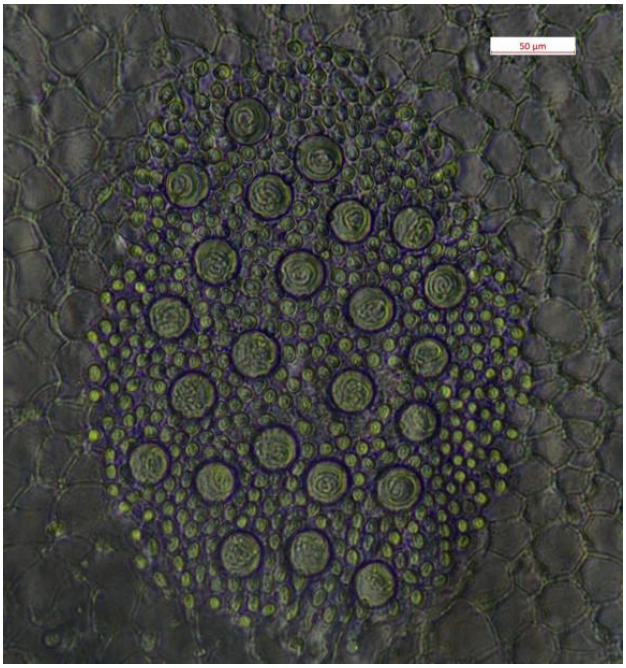


Figure 1: Battery of nematocysts (undischarged) in a tentacle of *R. nomadica*.

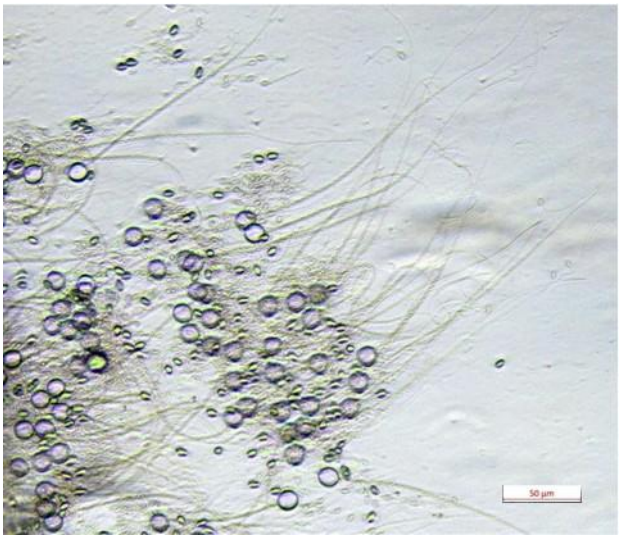


Figure 2: Discharged nematocysts in a tentacle of *R. nomadica*.

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

02. Materials Science

P-42

MODULATING THE CURVATURE OF PROTEIN SELF-ASSEMBLED SPIRAL NANOTUBULES

Ariel Cohen[1], Itai Ben-Nun[1], Israel Ringel[3], Ran Zalk[4], Yael Levi-Kalisman[2], Gabriel A. Frank[4], Uri Raviv[1]

[1]*Institute of Chemistry, The Hebrew University of Jerusalem, Jerusalem, Israel*
[2]*The Harvey M. Krueger Family Center for Nanoscience and Nanotechnology, The Hebrew University of Jerusalem, Jerusalem, Israel*
[3]*Institute for Drug Research, The School of Pharmacy, Faculty of Medicine, The Hebrew University of Jerusalem, Jerusalem, Israel*
[4]*Department of Life Sciences, Ben-Gurion University of the Negev, Beer-Sheva, Israel*

Structural transformations from ribbons to twisted ribbons to helical ribbons are often observed across supramolecular assemblies and in macroscopic structures and can be described under a consistent theoretical framework. Conical molecular self-assembled structures, however, are rarely observed, may require more than one subunit, their dimensions are hard to control, and are poorly understood. Cytoskeleton microtubule (MT) is a dynamic protein-polymer that self-assembles from αβ-tubulin heterodimer, providing mechanical support to Eukaryotic cells. Colchicine is a drug known to bind the exchangeable nucleotide site on the β-tubulin subunit and suppress MT assembly. The tetravalent polyamine spermine promotes MT assembly and tubulin spiral structures, including conical tubulin spirals, tubules of conical spirals, and inverted helical tubules. Here we show how colchicine as a single agent suppressed MT and tubulin single ring assembly already at substoichiometric concentrations, whereas in the presence of spermine, the tubulin-colchicine stoichiometry controlled the dimensions and curvature of tubulin spiral assemblies. At a fixed spermine concentration, the concentration of colchicine modulated the radii of the nanotubular structures. The radii of the inverted helical nanotubules and conical spiral nanotubules monotonically decreased with colchicine concentration. We attribute our observation to the increased curvature of the tubulin dimer subunit induced by colchicine.

POSTER PRESENTATIONS (Thursday, May 14, 2026 ,13:00)

02. Materials Science

P-43

IN-SITU ELECTRON MICROSCOPY FOR LOCAL INTERFACIAL ELECTRICAL CHARACTERIZATION OF HEUSLER ALLOY Fe_2VAl WITH ITS METALLIC CONTACTS

Avia Greenberg[1], Amram Azulay[1], Hanna Bishara[1]
The Iby and Aladar Fleischman Faculty of Engineering, Department of Materials Science and Engineering, Tel -Aviv university, Tel-Aviv, Israel

Thermoelectric (TE) materials enable the direct conversion of heat into electricity, and vice versa, through the Seebeck effect, offering promising solutions for sustainable energy generation and waste heat recovery. The Fe_2VAl-based Heusler alloy is a highly promising candidate for thermoelectric applications due to its cost efficiency, environmental friendliness, and high-power factor (5 $mWm^{-1}K^{-2}$ at 300 K) [1].

Contacts at the interfaces between dissimilar materials play a critical role in determining electrical and thermal performance yet achieving an efficient metal-Heusler interface remains a challenge [2]. Therefore, the practical integration of Fe_2VAl, serves as a model system for other Heusler alloys, into thermoelectric devices depends on minimizing interfacial resistance and decreasing its thermal conductivity [2], [3].

This research investigates the key factors affecting resistance at the Fe_2VAl/metal contact using a set of experimental approaches, with a primary focus on in-situ scanning electron microscopy (SEM) four-point probe measurements. This approach enables a direct correlation between local electrical properties and interfacial microstructure, complemented by transmission electron microscopy (TEM) characterization that reveals nanoscale microstructure and phase composition. By probing electrical transport at high spatial resolution across micro and nanoscale length scales, the study investigates how microstructural features influence contact resistance in thermoelectric materials. This integrated approach enables a detailed understanding of how microstructural characteristics and defects impact the electrical behavior at the Heusler/metal interface, offering new insights into interface optimization and performance enhancement.

The joints of the alloy with different metals and interlayers are investigated using three bonding methods: tube furnace bonding, arc melting, and spark plasma sintering (SPS), all performed under an inert atmosphere. Diffusion couples have been formed with Cu, Ti, and Fe. Microstructural characterization of the Fe_2VAl /Cu interface revealed the presence of an iron-vanadium sigma phase and copper-rich precipitates, as confirmed by electron diffraction.

The resistivity values measured in $\Omega \cdot \mu m$ are 1.6 ± 0.2 for copper, 4.3 ± 0.2 for the sigma phase and 8.5 ± 0.2 for the Heusler. These values are higher than expected, reflecting the local nature of the measurements near or within the interface. TEM revealed numerous structural defects in these areas, which are likely to affect the local electrical response. Additional measurements will be conducted to better resolve the spatial variation of resistivity across the interfaces.

We expect that mechanical defect engineering and chemical doping of the contact region with different dopants will reduce the interfacial resistance by enhancing electrical conductivity. The findings are expected to provide practical design guidelines for efficient engineering of thermoelectric interfaces, with broader implications for metal-Heusler systems used in electronics, sensing, and energy harvesting.

References:

[1] M. Mikami, K. Kobayashi, T. Kawada, K. Kubo, and N. Uchiyama, 'Development and evaluation of high-strength Fe2VAl thermoelectric module', Jpn. J. Appl. Phys., vol. 47, no. 3 PART 1, pp. 1512–1516, Mar. 2008, doi: 10.1143/JJAP.47.1512.

[2] G. Roy et al., 'Global Analysis of Influence of Contacts on Heusler-Based Thermoelectric Modules', J. Electron. Mater., vol. 48, no. 9, pp. 5390–5402, Sep. 2019, doi: 10.1007/s11664-019-07137-2.

[3] D.M. ROWE, Ed., Thermoelectrics handbook macro to nano. CRC Press, 2006.

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

02. Materials Science

P-44

ELECTRON MICROSCOPY FOR FAILURE ANALYSIS AND PROCESS WINDOW IDENTIFICATION IN ION MILLING OF SUPERCONDUCTING INTERFACES

Doron Gurovich[1], Or Ben Ishayah[2], Dr. Sergei Remennik[3], Dr. Anna Radko[3], Atzmon Vakahi[3], Maurice Saidian[1], Roee Barkai[4]

[1]*Center for Nanoscience and Nanotechnology, Unit for Nanofabrication (UNF), Hebrew University Jerusalem, Jerusalem, Israel*

[2]*Macroscopic Quantum Coherence Lab (QCL), Racah Institute of Physics, Hebrew University Jerusalem, Jerusalem, Israel*

[3]*Center for Nanoscience and Nanotechnology, Unit for Nano Characterization, Hebrew University Jerusalem, Jerusalem, Israel*

[4]*Quantum Optics and Quantum Information Laboratory, Racah Institute of Physics, Hebrew University Jerusalem, Jerusalem, Israel*

Ion milling is widely used to remove native oxide layers prior to metal deposition in superconducting device fabrication. However, the acceptable process window is narrow: insufficient milling leaves oxide residues, while excessive milling causes metal loss and substrate damage. Reliable process optimization therefore requires direct characterization of buried interfaces.

In this work we demonstrate how electron microscopy can serve as a central tool for both failure analysis and process optimization of ion milling in superconducting thin-film fabrication.

Cross-sectional focused ion beam transmission electron microscopy (FIB/TEM) analysis of fabricated aluminum structures revealed an unexpected interface layer between two aluminum films. Elemental mapping identified the presence of Fe, Cr, and Ni at the interface, indicating contamination originating from stainless-steel sputtering inside ion source hardware components. This observation enabled rapid identification of the failure mechanism and led to replacement of the ion source.

Following replacement of the ion source with a broad-beam ion source of a different design, the fabrication sequence was repeated and TEM analysis confirmed that the contamination had been eliminated. At the same time, microscopy revealed interface roughening and argon implantation under certain milling conditions, indicating that the process had entered an over-etch regime.

To guide further optimization, sputtering theory and literature data were used to estimate oxide removal times as a function of ion energy and current density. Complementary TEM and atomic force microscopy (AFM) measurements are used to determine the optimal milling conditions where oxide removal is achieved without damaging the metal layer or substrate.

This work illustrates how electron microscopy enables rapid diagnosis of fabrication failures and provides critical feedback for optimization of ion-milling processes in nanofabrication workflows.

POSTER PRESENTATIONS (Thursday, May 14, 2026 -13:00)

02. Materials Science

P-45

RAMAN MICROSCOPY FOR IMAGING CHEMICAL PHASE HETEROGENEITIES IN NICKEL HYDROXIDE ELECTRODES

David Ellis[1], Avihay Ben-Shitrit[1], Elena Praznikov[1], Avner Rothschild[1]
Materials Science and Engineering, Technion Israel Institute of Technology, Haifa, Israel

Nickel hydroxide electrodes play a significant technological role in batteries and electrolysis applications. While several studies investigating charging or aging mechanisms have successfully used Raman Spectroscopy to track the average $Ni(OH)_2$ phase, a still under-explored aspect is the spatial distribution of different phases of $Ni(OH)_2$ and how they evolve during electrochemical processes [1]. In this poster we show how Raman Microscopy can reveal the spatial dimension of phase distribution in this material. We present examples from a variety of different $Ni(OH)_2$ samples and Raman microscopy techniques/conditions : (a) A "true-surface^{TM}" scan on a hydrothermally deposited $Ni(OH)_2$ layer, which simultaneously measures topography and shows an in-crater region of alpha-phase $Ni(OH)_2$ surrounded by a sea of beta-phase; (b) a line-depth scan of $Ni(OH)_2$ electrodeposited on a mechanical pencil lead; (c) a sample immersed in water, imaged with an immersion lens ; (d) partially discharged electrode in an operando electrochemical cell, showing microscale heterogeneity of $Ni(OH)_2$ / NiOOH phases. Thus micro-Raman imaging is a tool that can provide a whole new way of viewing and understanding phase transitions in $Ni(OH)_2$ electrodes.

[1] A. Kurilovich, A. Ben-Shitrit, D. S. Ellis, N. Port, N. Gavish, A. Yochelis and A. Rothschild, "Nonuniform charging and phase front instability in nickel (oxy)hydroxide thin-film electrodes", accepted for publication in EES Batteries

POSTER PRESENTATIONS (Thursday, May 14, 2026 -13:00)

02. Materials Science

P-46

ANGLE RESOLVED FULL STOKES POLARIZATION MEASUREMENT OF SMITH PURCELL RADIATION

Feiyan Zhao[1], Zahava Barkay[2], Ady Arie[1,2]
[1]*School of Electrical and Computer Engineering, Fleischman Faculty of Engineering, Tel Aviv University, Tel Aviv, Israel*
[2]*Jan Koum Center for Nanoscience and Nanotechnology, Tel Aviv University, Tel Aviv, Israel*

Smith Purcell radiation (SPR), generated when free electrons propagate in close proximity to a periodic nanostructure, represents an important platform for investigating electron-photon interactions and developing tunable light sources. Although the spectral and angle-resolved properties of SPR have been extensively studied, its polarization characteristics still lack a systematic and comprehensive understanding. In this work, we report an angle-resolved full Stokes polarization measurement of Smith Purcell radiation. By combining angle-resolved detection with complete polarization analysis, we extract the full set of Stokes parameters (S0, S1, S2, S3) over a wide angular range. This approach enables a quantitative characterization of both linear and circular polarization components and reveals their dependence on the geometric parameters of the nanograting, including the duty cycle and rotation. Our results provide direct, full-state polarization characterization of SPR, establishing a route to polarization engineering of this radiation via nanogratings and opening opportunities for compact radiation sources, beam diagnostics of charged particles, and polarization-sensitive detection.

POSTER PRESENTATIONS (Thursday, May 14, 2026 -13:00)

02. Materials Science

P-47

MIXED PHASE TIO2 NANOTUBES SUPPORT FOR ENHANCED HER IN NEAR-NEUTRAL PH ELECTROLYTE

Matan Sananis, Elena Davydova, **Anna Breytus**[1], Avner Rothschild
Materials Science and Engineering, Technion - Israel Institute of Technology, Haifa

Green hydrogen produced through water electrolysis using renewably generated electricity could become a vital energy carrier and be utilized for the production of ammonia and steel in the coming years. Hydrogen production via decoupled water electrolysis using the bromide/bromate redox couple offers innovative solution to address the challenges of conventional electrolysis, while working in a near pH-neutral NaBr electrolyte.

This work reports a `job-sharing` effect between mixed-phase TiO2 nanotube support that stores protons and provides them to Ru nanoparticles, catalysing the hydrogen evolution reaction in Ti-based cathodes with ultra-low Ru loading (~4 mg/cm2). Well dispersed Ru NPs were obtained on the TiO2 support, confirmed by HRSEM and TEM images, as well as by EDS elemental mapping, with an average particle size of 3.4 1.8 nm (averaged over ~60 NPs in different TEM images). A small number of larger agglomerates (10-20 nm) were observed, far fewer than the 2-5 nm NPs. HRTEM images of a single Ru NP show a lattice with d-space of 0.214 nm that corresponds to (002) planes in metallic Ru.

To examine fine microstructural changes, we compare TEM images of as-prepared Ru/TiO2 electrode and after 125 h of electrolysis. We find that the Ru NPs remain sparsely distributed along the TiO2 nanowires, with an average size of 4.7 ± 1.7 nm, similar to the as-prepared electrode (3.4 ± 1.8 nm), and with similar 10-20 nm agglomerates. High magnification TEM comparison followed by TEM-EDS elemental mapping reveals a nanometer thick Cr-based coating on the Ru NPs and the TiO2 nanotubes after electrolysis. This coating is attributed to the formation of a protective chromium oxide/hydroxide layer, most likely Cr(OH)3, which is deposited during electrolysis to prevent redox of bromate anions and other oxidized bromine species. In addition to the prevention of parasitic cathodic reactions, this overlayer encapsulates the Ru NPs on the TiO2 support, preventing their agglomeration during electrolysis. These promising results pave a path forward for viable water electrolysis in pH-neutral electrolytes.

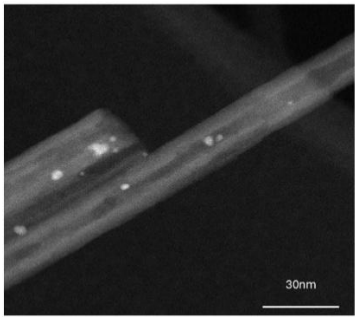


Figure 1. Ru nanoparticles on TiO_2 nanotubes

POSTER PRESENTATIONS (Thursday, May 14, 2026 -13:00)

02. Materials Science

P-48

CHEMOELASTIC EFFECTS, PHASE EQUILIBRIA, AND UPHILL DIFFUSION IN Cu-Pd NANOPARTICLES

Idan Klein[1], Feitao Li[1], Eugen Rabkin[1]
Department of Materials Science and Engineering, Technion - Institute of Technology, Haifa, Israel

We fabricated nanoparticles (NPs) of Cu-40 at.% Pd alloy via solid state dewetting and subsequent slow-cooling of Cu-Pd bilayers deposited on a sapphire substrate. We observed that some nanoparticles which experienced partial transformation from a disordered A1 FCC phase to the ordered B2 β-CuPd exhibited compositional discontinuity, with the ordered phase being richer in Pd. This compositional discontinuity was associated with fully or partially coherent interphase boundary. At the same time the FCC particles that did not experience any transformation, the fully transformed β-CuPd particles, and partially transformed particles with incoherent interphase boundary exhibited homogeneous distribution of the components. We developed a thermodynamic model which demonstrated that misfit-strain from the coherent interface influences the thermodynamics of the system, depressing the transformation temperature. Re-distribution of the components causes changes to the lattice parameter of each of the phases, mitigating the misfit between them, reducing free energy and encouraging the phase transformation.

POSTER PRESENTATIONS (Thursday, May 14, 2026 -13:00)

02. Materials Science

P-49

LET IT BE: DESIGN AND HIGH-RESOLUTION CRYO-EM STRUCTURE OF AN ENGINEERED PROTEIN ASSEMBLY

Shaked Katzelnick[1], Yuval Shoham[1], Dganit Danino[1,2]
[1]*Faculty of Biotechnology and Food Engineering, Technion-Israel Institute of Technology, Haifa, North, Israel*
[2]*Department of Biotechnology and Food Engineering, Guangdong Technion-Israel Institute of Technology, Shantou, Guangdong, China*

Protein self-assembly is a fundamental biological process in which proteins spontaneously organize into ordered supramolecular structures through non-covalent interactions such as hydrophobic forces, electrostatics, and hydrogen bonding. This process is often associated with biological function and represent a key principle of molecular organization. Beyond its biological importance, understanding protein self-assembly forms the basis for protein engineering and supports a wide range of applications in nanotechnology, structural biology, and biophysics.

The present research focuses on elucidating the mechanisms underlying protein ultrastructure formation and developing strategies to engineer and control self-assembly processes. Our building blocks were acetylxylan esterase (Axe2) octamer rings of *Geobacillus proteiniphilus* (*G. proteiniphilus*), a thermophilic bacterium growing optimally at 60-65 °C and neutral pH [1]. The thermophilic origin of Axe2 provides enzyme stability suitable for structural and biochemical studies

Mutations at distinct positions of the octameric ring, as well as the selection of specific type of amino acid substitution, dictated the formation of several unique higher-order assemblies. Substitution of a surface-exposed serine residue with cysteine at both the top and bottom surfaces of the ring led to the formation of long, separated nanotubes (Fig. 1A). In contrast, replacement of a negatively charged residue with a sticky hydrophobic tyrosine at the same location promoted self-assembly into bundles, driven by hydrophobic interactions (Fig. 1B). Introducing a similar tyrosine substitution along the lateral surface of the ring resulted in the formation of highly ordered, crystal-like assemblies (Fig. 1C). Using cryo-electron microscopy (cryo-EM) methods, including single-particle analysis (SPA) with helical reconstruction, the ultrastructure, made of staggered rings forming a nanotube architecture, was resolved at near-atomic resolution (~ 3.6 Å, Fig. 2). Furthermore, the helical architecture of the bundles was found to be chiral by cryo-electron tomography (cryo-ET).

These findings establish a foundation for engineering controllable protein-based ultrastructures and they contribute to a broader understanding of self-assembly as a design principle in structural biology and materials science.

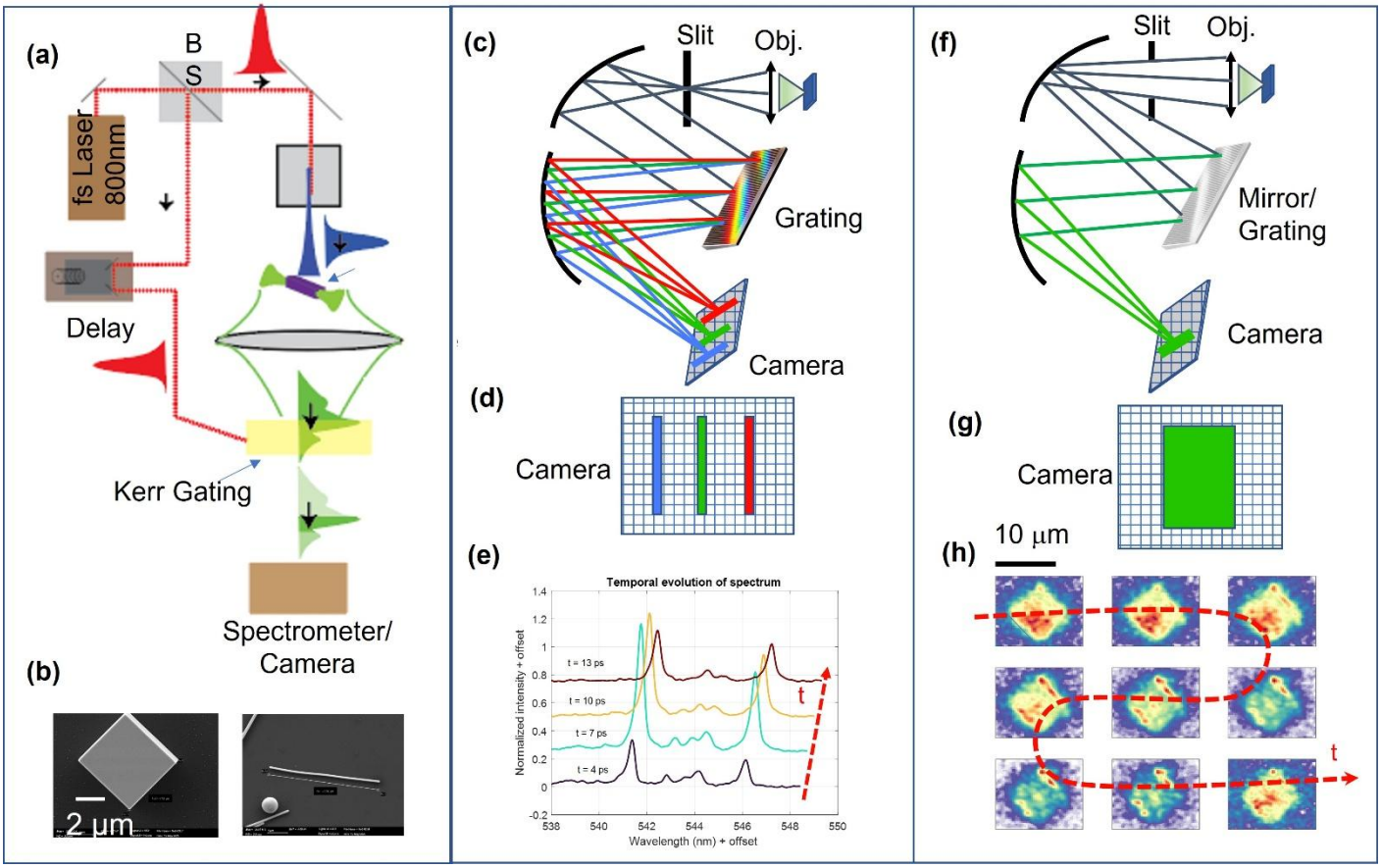


Fig. 1. Cryo-EM images of the new assemblies. A) Individual protein nanotubes with different lengths; B) Protein bundle; C) Protein crystal-like assembly. Scale bar in all panels = 50nm.

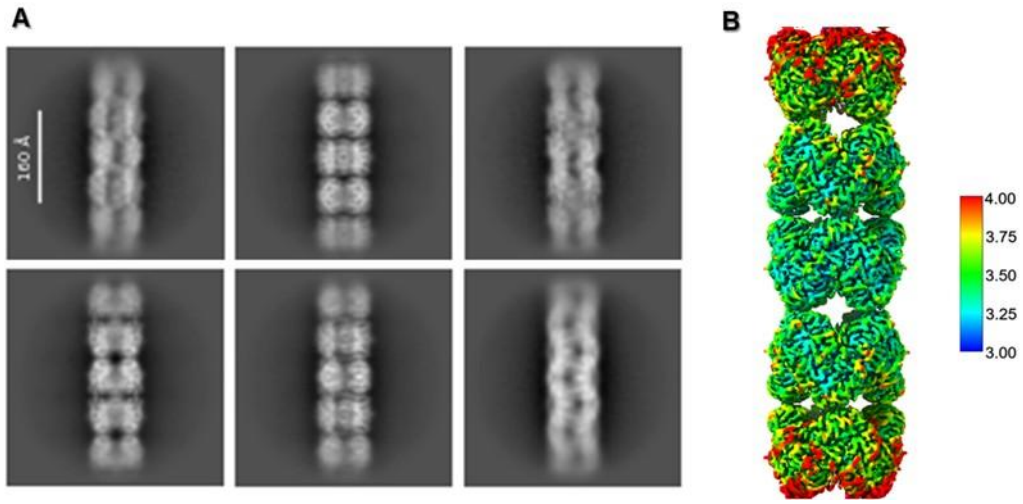


Fig. 2. Cryo-EM structure of the Axe2 nanotubes. A) Two-dimensional (2D) classes of the nanotubes; B) The cryo-EM map of the nanotubes.

References:

1. Lansky S et al. Acta Crystallographica Section D: Biological Crystallography (2014) 70 261-278. https://doi.org/10.1107/S139900471302840X

POSTER PRESENTATIONS (Thursday, May 14, 2026 -13:00)

02. Materials Science

P-50

ENABLING NANOSCALE EXAMINATION OF TWO-DIMENSIONAL MATERIALS – $Ti_3C_2T_x$ MXENES – WITH 4D-STEM

Kirill Sobolev[1], Mridul Kumar[1], Alexander Upcher[2], Vladimir Ezersky[2], Yevgeny Rakita[1,2]

[1]*Materials Engineering, Ben Gurion University of the Negev, Beer Sheva, Israel*
[2]*Ilse Katz Institute for Nanoscale Science and Technology, Ben Gurion University of the Negev, Beer Sheva, Israel*

MXenes are an inspiring family of two-dimensional (2D) materials with the general formula $M_{n+1}X_nT_x$, where M is a transition metal, X is Carbon and/or Nitrogen, and T_x is a surface termination group (e.g., −F, =O, −OH) [1]. MXenes are advantageous for a number of fields, including energy storage and harvesting, catalysis, sensors, etc. [2] Due to their 2D nature, the functional properties of MXenes are highly sensitive to the nanoscale features of the flakes, such as edges, defects, or intercalated species [3,4]. Thus, to thoroughly assess their quality, proper characterization must be performed at both macro- and nanoscale. While macroscopic techniques (XRD, XPS, Raman spectroscopy, etc.) are well established [5], comprehensive nanoscale examination tools remain scarce. Such tools should be able to distinguish local features, such as pores, defects or oxidation traces, and cross-correlate them with the local chemistry of a flake. A few available examples of nanoscale MXene analysis employ scanning tunneling microscopy [6] and multimodal X-ray spectromicroscopy [7]. These techniques are highly complex and rely on specialized facilities, such as a synchrotron in the latter case. Achieving comparable or complementary data using lab-scale tools, such as scanning transmission electron microscopy (STEM), would make nanoscale characterization of MXenes far more accessible.

In this work, we use 4D-STEM [8] to gain a unique insight into the structural nature of $Ti_3C_2T_x$ MXene flakes. By simultaneously acquiring chemical (EDS) and structural (CBED) information in a scanning mode, we generate high-resolution contrast maps of the MXene flakes with a spatial resolution of 1.5 nm. We employ commercially-available software for indexing electron diffraction patterns with respect to the reference structural model, and we strengthen it with a uniquely developed Machine Learning (ML) based analysis pipeline.

Starting from a high-quality $Ti_3C_2T_x$ MXenes, prepared via HCl+HF approach [9], we show that 4D-STEM allows distinguishing fine structural features, including defects, and *in-flake* grain boundaries. Next, we follow the evolution of $Ti_3C_2T_x$ flakes upon deliberate degradation through oxidation or severe ultrasonication. In this case, ML-assisted clustering of the 4D-STEM dataset enables in-depth analysis of MXene degradation pathways and their spatial localization. To expand the capabilities of the proposed method, we also studied a MXene-based heterostructure, e.g., the cross-section of a $Ti_3C_2T_x$ – $MAPbI_3$ halide perovskite thin film. To the best of our knowledge, this is the first example of using 4D-STEM for nanoscale examination of $Ti_3C_2T_x$ MXenes; and we clearly demonstrate that this method holds huge potential for high-throughput characterization and quality-control of 2D materials.

[1] M. Naguib, et al. Adv. Mat. 23(37), 4248-4253, 2011.

[2] Y. Gogotsi, and B. Anasori. ACS Nano, 13(8), 8491-8494, 2019.

[3] J.L. Hart, et al. Nat. Comm., 10, 522, 2019.

[4] M. Downes, et al. Nat. Protocols, 19, 1807-1834, 2024.
[5] M. Shekhirev, et. al. Prog. in Mat. Sc., 120, 100757, 2021.
[6] K.E. White, et al. Matter, 7, 2609-2618, 2024.
[7] F. Amargianou, et al. Small Methods, 8(12), 2400190, 2024.
[8] Y. Rakita, et al. Acta Mater., 242, 118426, 2023.
[9] A. Thakur, et al. Small Meth., 7(8), 2300030, 2023.

POSTER PRESENTATIONS (Thursday, May 14, 2026 -13:00)

02. Materials Science

P-51

NANOSCALE POLY(A)MORPHISM OF PVDF THIN FILMS

Lior Snarski[1], Boris Rybtchinski[1]
Department of Molecular Chemistry and Materials Science, Weizmann Institute of Science, Rehovot, Israel

Polyvinylidene fluoride (PVDF) thin films are widely studied for their potential in sensors, actuators, and energy harvesting applications, owing to the ferroelectric properties of the electroactive β-phase. Langmuir–Blodgett (LB) technique commonly used to produce βphase rich ultrathin PVDF films; however, despite containing a significant amount of the electroactive phase, functional ferroelectric performance requires stacking multiple LB layers. To date, the crystal structure of the active layer has been characterized using low lateral resolution techniques such as X-ray diffraction (XRD) and Fourier-transform infrared (FTIR) spectroscopy, which produce superimposed spectra from various nanometric features of the LB film. Herein, we employ four-dimensional scanning transmission electron microscopy (4D-STEM) and nano-FTIR spectroscopy to identify the polymorphs present in a single LB layer. Distinct morphological features within the LB film exhibit different crystalline phases: a well-known non-polar α-phase and a mesophase with structural characteristics resembling the β-phase.

POSTER PRESENTATIONS (Thursday, May 14, 2026 -13:00)

02. Materials Science

P-52

PYSTEMLAB: A WEB APPLICATION FOR REAL-TIME 4D-STEM SPACE NAVIGATION, DRIFT CORRECTION, AND UNSUPERVISED PHASE CLUSTERING FOR NANOSCALE PHASE DISCOVERY

Mridul Kumar[1], Kirill Sobolev[1], Yevgeny Rakita[1,2]
[1]*Materials Engineering, Ben-Gurion University of the Negev, Be'er Sheva, Israel*
[2]*Ilse Katz Institute for Nanoscale Science, Ben-Gurion University of the Negev, Be'er Sheva, Israel*

4D-STEM enables rich nanoscale insights into structure, strain, fields, and phases, but raw datasets are large and analysis remains computationally intensive and non-intuitive. Web-based tools can democratize access, enable interactive exploration, and integrate GPU acceleration for faster workflows, especially valuable in research environments with diverse user expertise. Here, we present PySTEMLab, a Python-based web application which is build with Dash and Plotly – a modern web-based graphing library. The current features (see Figure) of PySTEMLab include:
A. Pre-processing tools such as drift correction, essential for accurate virtual imaging, quantitative mapping, and high-quality ML-based clustering, is particularly relevant for long or sequential acquisitions.
B. Bidirectional visualization tools to navigate seamlessly between diffraction space (patterns, virtual field) and real space reconstructions (virtual field maps), facilitating intuitive data exploration.
C. Machine learning pipeline using convolutional neural network (CNN) autoencoders for feature extraction from diffraction patterns, followed by UMAP dimensionality reduction to generate latent space representations. Users can interactively select clusters in the 2D UMAP scatter plot, with immediate overlay of corresponding real-space positions to reveal spatially distinct phases, domains, or structural heterogeneities with the average diffraction patterns from those domains.
PySTEMLab works directly in the browser from a server and reduces the need to install heavy software packages for computation. By combining GPU speed, ML-driven unsupervised analysis, and web accessibility, PySTEMLab lowers entry barriers to advanced 4D-STEM, promotes reproducibility, and accelerates materials discovery.

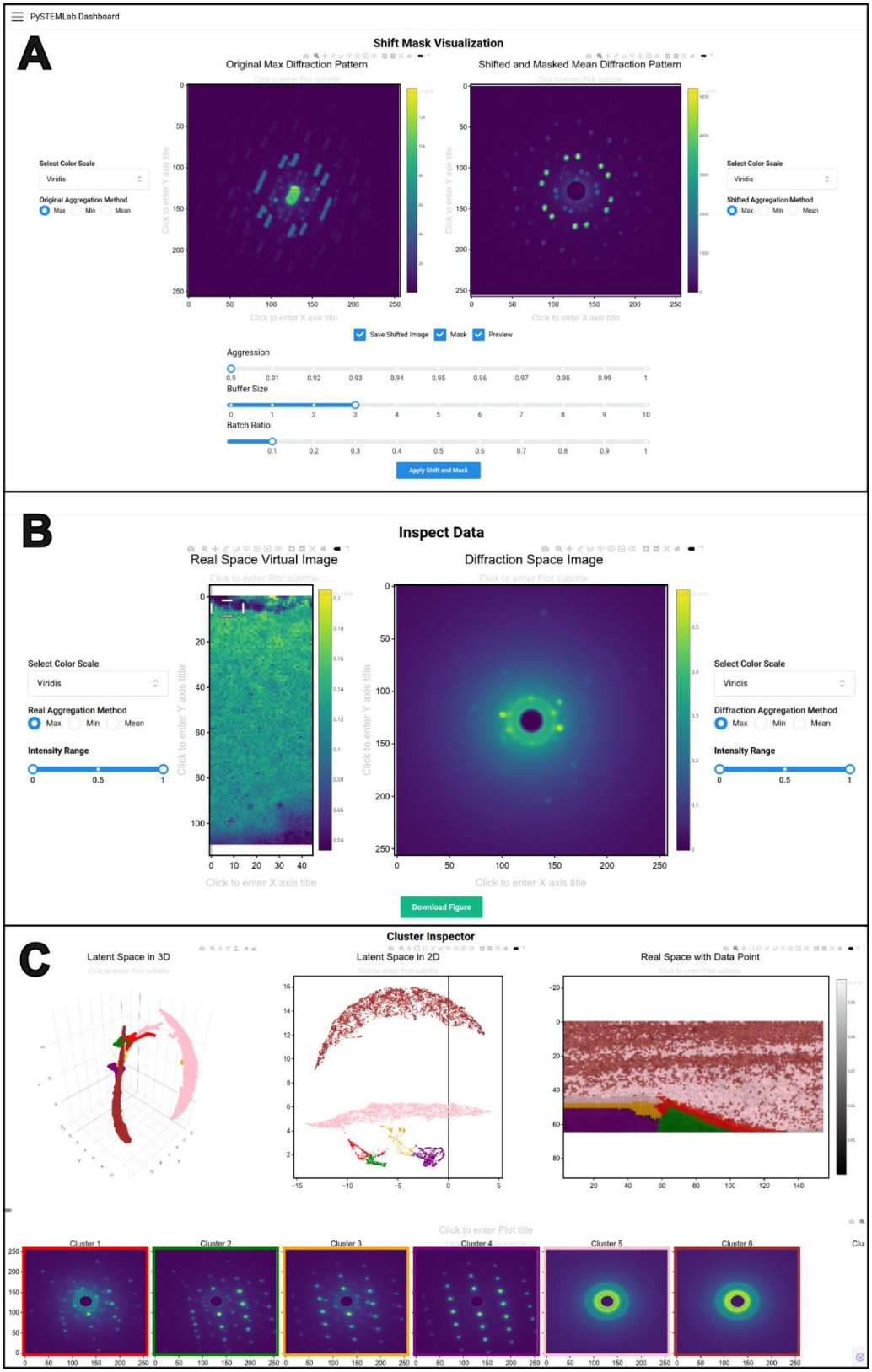


Figure: We demonstrate PySTEMLab`s capabilities on experimental 4D-STEM dataset of MXenes, oxides, and phase change materials (Ge-Sb-Te) showcasing (A) rapid drift-corrected (B) virtual imaging, and (C) interactive discovery of nanoscale features, phase segregation mapping via latent clusters.

POSTER PRESENTATIONS (Thursday, May 14, 2026 -13:00)

02. Materials Science

P-53

MAPPING THE CRYSTALLIZATION MECHANISM OF POLYLACTIC ACID UNDER MELT FLOW CONDITIONS VIA 4D-STEM

Nadav Yahalom[1], Lior Snarsky[1], Boris Rybtchinski[1]
Molecular Chemistry and Materials Science, Weizmann Institute of Science, Rehovot, Israel

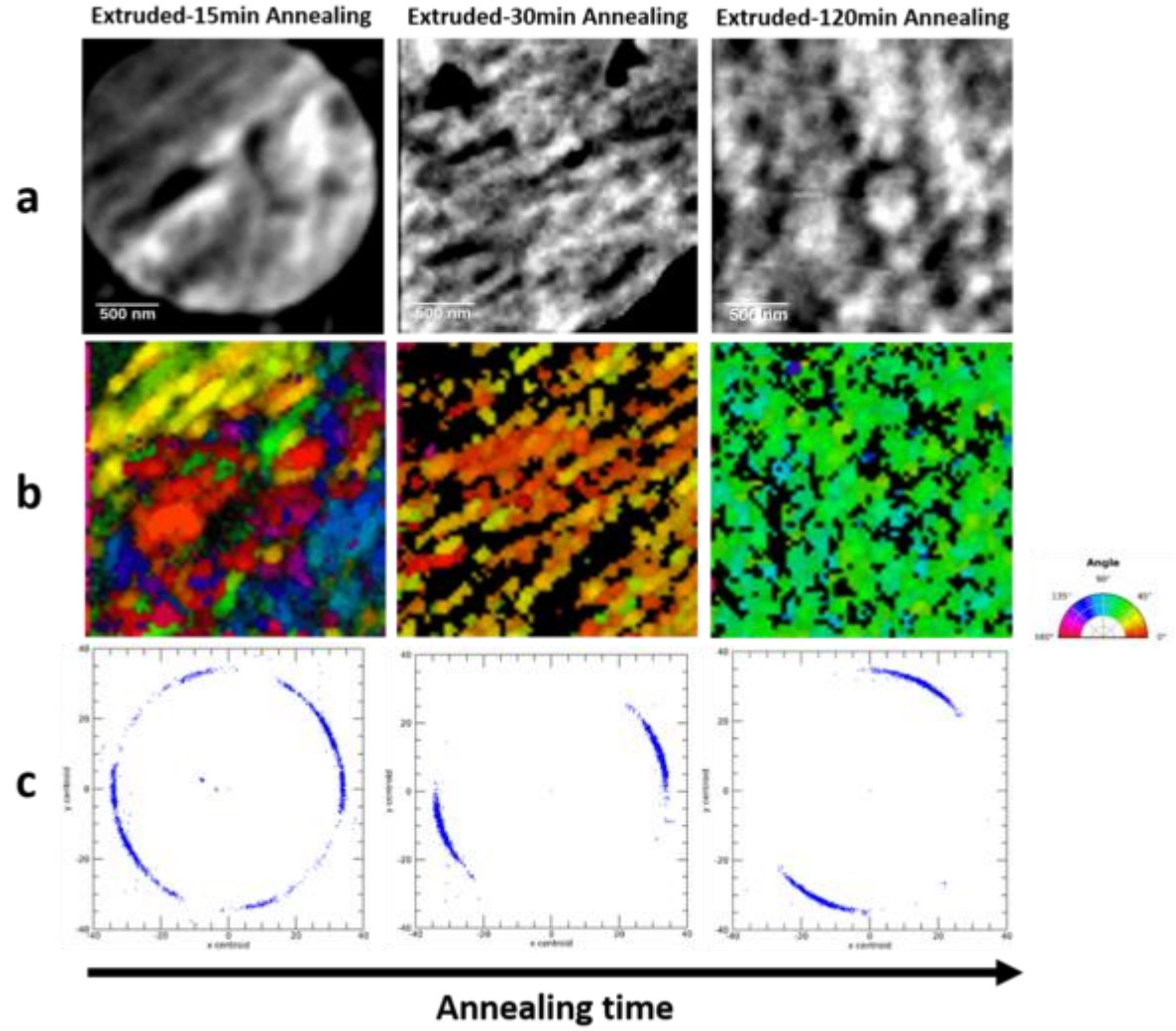
The macroscopic thermal and mechanical properties of Polylactic Acid (PLA), a leading sustainable and biodegradable polymer, is dictated by its final nanoscale crystal structure [**1**]. Understanding this structural evolution, particularly under industrial melt-flow processing conditions, remains a significant scientific bottleneck. Probing such dynamic, nanoscale phenomena for electron-beam-sensitive polymer presents a primary microscopy challenge [**2**].

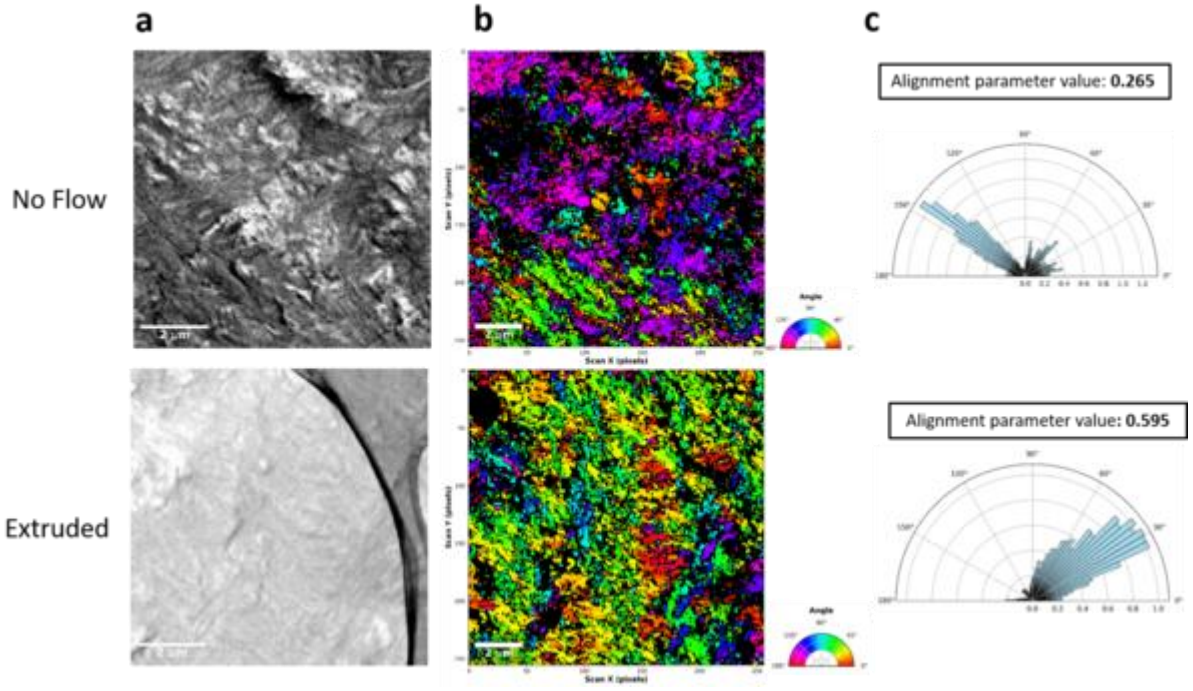
To address this, we used 4D-Scanning Transmission Electron Microscopy (4D-STEM) as our core technique to examine PLA samples annealed isothermally at 110 °C, specifically comparing those prepared by twin-screw extrusion (melt flow) with those under quiescent conditions (no flow). We also integrated a broad set of characterization tools—including ssNMR, Low-frequency Raman spectroscopy, XRD, and DSC—to connect our high-resolution nanoscale maps with the macroscopic bulk properties. Together, this multi-scale approach, enabled a comprehensive analysis of how the extrusion process and the associated melt flow strongly dictate the crystallization mechanism and chain alignment.

A central part of this research is developing custom computational tools to analyze 4D-STEM data. While we designed these tools to answer our specific questions regard PLA crystallization mechanism—particularly mapping localized lamellar orientation at the nanoscale—the analysis framework itself is highly adaptable. Beyond our specific system, it can be used to study a wide range of other complex materials in soft matter and polymer physics.

References

[**1**] Farah, S., Anderson, D. G., & Langer, R. (2016). Physical and mechanical properties of PLA, and their functions in widespread applications—A comprehensive review. Advanced drug delivery reviews, 107, 367-392.
[**2**] Ophus, C. (2019). Four-dimensional scanning transmission electron microscopy (4D-STEM): From scanning nanodiffraction to ptychography and beyond. Microscopy and Microanalysis, 25(3), 563-582.


Extruded-15min Annealing
Extruded-30min Annealing
Extruded-120min Annealing
a
b
c
500 nm
Angle
Annealing time


a
b
c
No Flow
Extruded
Alignment parameter value: 0.265
Alignment parameter value: 0.595

POSTER PRESENTATIONS (Thursday, May 14, 2026 -13:00)

02. Materials Science

P-54

KELVIN PROBE FORCE MICROSCOPY OF $CoFe_2O_4$-$BaTiO_3$ CORE-SHELL NANOWIRES UNDER MAGNETIC FIELD

Neta Gal[1], Yonatan Calahorra[1]
Faculty of Materials Science and Engineering, Technion- Israel Institute of Technology, Haifa, Israel

Magnetoelectric (ME) coupling refers to the interaction between a piezoelectric response and a magnetostrictive response, where the electric and magnetic responses are linked through their shared strain-mediated coupling, as observed in multiferroic systems. These combined effects may be exploited for multifunctional devices, including novel memory and logic devices [1, 2]. We used CoFe2O4-BaTiO3 (CFO-BTO) core-shell ME nanowires, where spinel CFO is the magnetostrictive material and perovskite BTO is the piezoelectric material [2].

Kelvin Probe Force Microscopy (KPFM) is an Atomic Force Microscopy (AFM) mode that measures the potential difference between the AFM's tip and the sample surface [3]. Bruker's variable magnetic stage was used to vary the magnetic field without moving the sample. It changes the angle between the magnet and the stage, where the sample is, therefore the magnetic field applied to the sample changes accordingly. The bigger the angle, the stronger the magnetic field (up to 90°).

We scanned a sample of horizontally dispersed nanowires using KPFM with and without an applied magnetic field, using a variable field magnetic stage for AFM. Under an applied magnetic field the nanowires moved on the substrate and the measured electrostatic surface potential changed. Different nanowires exhibited distinct changes in surface potential under different magnetic fields.

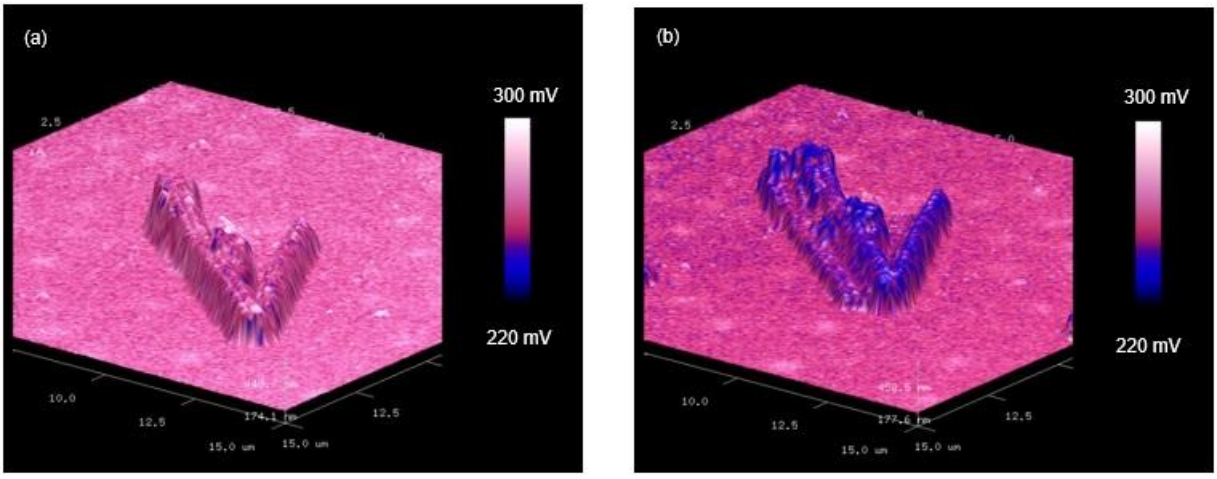


Fig. 1: CFO-BTO core-shell nanowires 3D mixed signal of potential contrast over height. (a) 0° angle between the sample to the magnet. (b) 30° degrees angle between the sample to the magnet.

[1] Y. Calahorra et al., Microscopy, Semiconductor Science and Technology, 32, 074006 (2017).

[2] N. D. Ferson et al., Tunable synthesis of magnetoelectric $CoFe_2O_4$–$BaTiO_3$ core–shell nanowires, Chemical Communications, 60, 14073 (2024).

[3] W. Melitz et al., Kelvin probe force microscopy and its application, Surface Science Reports, 66, 1–27 (2011), DOI:10.1016/j.surfrep.2010.10.001.

POSTER PRESENTATIONS (Thursday, May 14, 2026 13:00)

02. Materials Science

P-55

DISLOCATIONS INDUCED PERIODIC VARIATIONS OF INTERPLANAR SPACINGS OF 9R STRUCTURE IN CU

Saja Sarhan[1], Amram Azulay[1], Hanna Bishara[1]
Department of Materials Science and Engineering, The Iby and Aladar Fleischman Faculty of Engineering, Tel Aviv University, Tel Aviv, Israel

9R structures are often observed at incoherent twin boundaries in low stacking fault FCC metals and alloys. They consist of a periodic array of stacking faults defined by partial dislocations at the 9R-FCC interface. Despite the well-established atomic structure understanding, the 9R interplanar spacing and coherency state at FCC-9R is not resolved yet. This study focuses on resolving the atomic structure and interfacial coherence of metastable 9R phases formed at grain boundaries in a Cu-10 at. % Mn alloy. We show, by scanning transmission electron microscopy, that incoherent Σ3 grain boundaries facet into coherent segments as well as segments that include 9R complexions. Analysis of atomic-column resolution images reveals that interplanar spacings along the [0001]9R direction are not always equal, but rather vary periodically at three distinct modes, depending on the coherency of the 9R interface with the adjacent Cu grains or position in the 9R structure. These periodic variations are elucidated by arrays of partial dislocations at the 9R-Cu interface. The two opposite ends of the 9R phase are coherent and semi-coherent with the adjacent Cu grains. Additionally, we show that two adjacent 9R phases migrate due to interaction with a 300 keV electron beam and stabilize at a distance of 4.5 nm, probably by stacking faults. The results provide direct atomic-scale insight into the structural coherence and defect accommodation mechanisms at 9R–FCC interfaces.

POSTER PRESENTATIONS (Thursday, May 14, 2026 13:00)

02. Materials Science

P-56

THE EFFECT OF FRAGRANCE AND SALT MOLECULES ON SURFACTANT SELF-AGGREGATION IN AQUEOUS SOLUTIONS STUDIED BY CRYO-TEM

Sapir Lifshiz-Simon[1], Yeshayahu Talmon[1]
Chemical Engineering and the Russell Berrie Nanotechnology Institute (RBNI), Technion – Israel Institute of Technology, Haifa, Israel

The interaction between ions, organic additives, and charged surfactants is a fundamental phenomenon in colloid science. These interactions are important in many industrial surfactant-based products, which often contain added salts and fragrances to adjust their performance and properties. Although such formulations are widely used, and studies report that additives can significantly change the surfactant nanostructure and behavior, little is known about their precise effects on surfactant self-assembly at the nanometric scale. In our research, we study the effects of salts and fragrances on the self-aggregated nanostructure of surfactants.

We have investigated the nanoaggregation of a surfactant-based systems using cryogenic transmission electron microscopy (cryo-TEM) direct-imaging advanced techniques, including the Volta phase plate (VPP) to improve image contrast, following careful specimen preparation to minimize shear-induced artifacts.[1,2] Since the viscosity is strongly affected by the self-aggregated nanostructure of the surfactant, we perform rheological measurements to complement our imaging, and predict nanostructural changes. The surfactant model system we use is sodium lauryl ether sulfate (SLES), an important and commonly used surface-active agent that is usually formulated with other components, such as salts and fragrances. We examine how the nanostructure of SLES aggregates, and consequently the macroscopic behavior, changes by adding different salts (LiCl, NaCl, KCl, and CsCl) and fragrances (vanillin, limonene, citronellol, and linalool), at different salt-to-surfactant molar ratios (X).

In this study, we connect the rheological behavior of SLES with its nanostructural changes as a function of NaCl concentration,[1] and upon the addition of different fragrance molecules (Figure 1). We identify a variety of nanoaggregates and coexisting pseudo-phases in the NaCl-SLES-based systems containing fragrances. The nanoaggregates include spheroidal micelles, threadlike micelles (TLMs), either short or elongated, branched networks, and vesicles. These structural transitions are directly correlated with changes in macroscopic viscosity. We show that each additive slightly shifts the zero-shear viscosity peak, affecting both its magnitude and the salt concentration required to reach the maximum viscosity level. While our previous work[1] focused on ion-specific effects in SLES systems with different salts, here we extend the analysis to the addition of fragrance molecules, revealing their distinct influence on self-assembly and rheology. Additionally, we demonstrate how the shear of blotting during cryo-TEM specimen preparation can induce nanostructural artifacts, emphasizing the importance of careful specimen preparation in obtaining reliable structural information.[2]

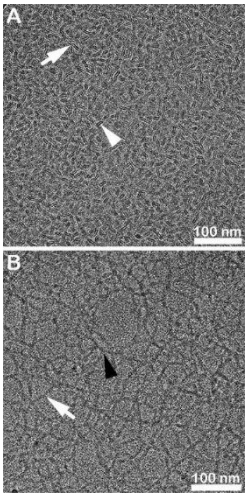


Figure 1. Cryo-TEM micrographs of 5 wt.% SLES solutions with NaCl and 1 wt.% linalool. (A) X=2, before the zero-shear viscosity peak, showing short (arrowhead) and elongated (arrow) thread-like micelles (TLMs). (B) X=6, after the peak, showing elongated TLMs (white arrow) forming a dense network with many branching points (black arrowhead).

POSTER PRESENTATIONS (Thursday, May 14, 2026 13:00)

02. Materials Science

P-57

STUDYING FLUORESCENT PROPERTIES OF OLIVE CARBON DOTS USING TIME-RESOLVED FLUORESCENCE MEASUREMENTS

Saidvaliev Ulugbek[1], Dror Fixler[1], Nataliia Dudchenko[2]
[1]*Faculty of Engineering, Tel Aviv University, Tel Aviv, Israel*
[2]*Bar Ilan Institute of Nanotechnology & Advanced Materials, Bar Ilan University, Ramat Gan, Israel*

In the modern world carbon derived nanoparticles (especially carbon dots - CDs) are revolutionizing nano-sensing and nanophotonic applications due to their unique properties (large surface area, tunable fluorescence, excellent biocompatibility, etc.). CDs were synthesized from bio-renewable sources (olive tree leaves) via a hydrothermal route and studied in our experiments using time-resolved frequency domain fluorescence lifetime imaging microscopy techniques. These nanoparticles demonstrate relatively modest changes in fluorescence lifetime (FLT) values of 5.0 ± 0.2 ns in water and glycerol solutions of different concentrations (0%, 30%, 60% and 80% glycerol) with fluorescence emission intensity increasing with the solution viscosity, i.e. glycerol concentration. Fluorescence anisotropy decay measurements showed increasing steady state anisotropy r_{ss} values from 0.058 ± 0.03 to 0.3 ± 0.03, while r0 remaining the same around 0.38 ± 0.02 and rotational correlation time θ growing significantly from 1.01 ± 0.02 ns to 16 ± 0.1 ns across all glycerol solutions with the increasing viscosity correspondingly. The study indicates that CDs retain relatively stable FLT in glycerol solutions, while θ shows evident changes in the viscosity and is most beneficial for reflecting variations in local spatial properties.

POSTER PRESENTATIONS (Thursday, May 14, 2026 13:00)

02. Materials Science

P-58

HARNESSING MICROALGAE FOR THE BIOSYNTHESIS OF MOLECULAR CRYSTALS

Avital Wagner, Noam Margalit, Avital Wagner, Noam Margalit, Alexander Upcher, **Yahel Fishman**[1], Mark Baranov, Mark Baranov, Einat Nativ-Roth, Colan E. Hughes, Benson M. Kariuki, Johannes S. Haataja, Einat Nativ-Roth, Lukas Schertel, Jonathan R. Yates, Kenneth D.M. Harris, Shashanka S. Indri, Allen R. Place, Peter Mojzes, Benjamin A. Palmer, Colan E. Hughes, Kenneth D.M. Harris, Allen R. Place, Benson M. Kariuki, Peter Mojzes, Benjamin A. Palmer, Johannes S. Haataja, Lukas Schertel, Jonathan R. Yates, Alexander Upcher

Department of Chemistry, Ben-Gurion University of the Negev, Beer-Sheba, Israel

Engineered microbial cells have been widely exploited as 'factories' for high value metabolites. A long-sought, but unrealized goal of bio-inspired materials would be to harness cells for the biosynthesis of functional crystalline materials. The recent discovery of guanine crystals in microalgae has afforded an opportunity to achieve this goal.[1] Molecular crystals like guanine are assembled into high-performance optical structures in animals, highlighting their potential as biocompatible alternatives to toxic inorganic scatterers.[2] However, controlling the structural and optical properties of these sparingly soluble crystals in vitro is a key stumbling block.[3] Here, we harness microalgae for the biosynthesis of difficult to crystallize molecular materials. We show that dinoflagellates can rapidly accumulate many N-heterocycles from aqueous solutions into nitrogen-storage crystals - revealing a general mechanism for their metabolism of dissolved organic nitrogen. This innate crystallization behavior is then manipulated to generate crystals with tailored morphologies and optical properties, including birefringent xanthine spherulites – a biogenic analogue of TiO_2. Our results show how microalgae may be artificially exploited as cellular factories for producing molecular crystals, whilst harnessing the intrinsic control mechanisms of crystal-forming cells. We anticipate this cellular platform may also be applied for the crystallization of pharmaceuticals and for the bioremediation of toxicants.

References: (1) Mojzeš, P. *et al.* Guanine, a high-capacity and rapid-turnover nitrogen reserve in microalgal cells. *Proc Natl Acad Sci USA* 117, 32722–32730 (2020). (2) Lemcoff, T. *et al.* Brilliant whiteness in shrimp from ultra-thin layers of birefringent nanospheres. *Nat Photonics* 17, 485–493 (2023). (3) Wagner, A. *et al.* Rationalizing the Influence of Small-Molecule Dopants on Guanine Crystal Morphology. *Chemistry of Materials* 36, 8910–8919 (2024).

POSTER PRESENTATIONS (Thursday, May 14, 2026 13:00)

02. Materials Science

P-59

AMORPHOUS SILICON NITRIDE FOR TEM PHASE MASKS AND MEMBRANES: MEAN INNER POTENTIAL AND MEAN FREE PATHS

Yair Yakov[1], Amram Azulay[1], Peter Rez[2], Lothar Houben[3], Amit Kohn[1]
[1]*Department of Materials Science and Engineering, The Iby and Aladar Fleischman Faculty of Engineering, Tel Aviv University, Tel Aviv 6997801, Israel*
[2]*Department of Physics, Arizona State University, Tempe, AZ 85287, USA*
[3]*Department of Chemical Research Support, Weizmann Institute of Science, Rehovot 7610001, Israel*

Amorphous silicon nitride (a-SiN) membranes are employed widely in transmission electron microscopy because this material is mechanically robust and chemically stable. Furthermore, its low-atomic number and mass density reduces electron scattering.

Consequently, a-SiN membranes serve to support nanoparticles and biological specimens, to encapsulate cells for in situ liquid and gas experiments and to construct phase masks and beam shaping devices. For these applications, an accurate knowledge of electron–matter scattering parameters is essential. In particular, the mean inner potential (MIP) determines phase modulation of the transmitted electron wave, while elastic and inelastic mean free paths (MFPs) determine scattering probability, beam attenuation, and preservation of coherence. Despite the extensive technological use of a-SiN membranes, the characterization of these electron-optical properties is lacking.

We present an experimental study of amorphous a-Si0.91N thin films deposited by low-pressure chemical vapor deposition. The film composition was verified by X-ray photoelectron spectroscopy, confirming a Si-rich composition. The structural short-range order and number density were characterized by total electron scattering measurements and X-ray reflectivity. The extracted pair distribution function reveals first and second nearest neighbor distances corresponding to tetrahedral Si–N and Si–Si bonds.

The MIP was measured using off-axis electron holography on wedge-shaped specimens (Fig. 1a, ~40°). The electrostatic phase shift was measured as a function of local specimen thickness from holograms of the a-SiN layer (Fig. 1b). An example of a reconstructed wrapped phase is shown in Fig. 1c. The MIP was extracted from the linear relationship between the unwrapped phase and position (Fig. 1d) combined with the wedge angle. The measured MIP is larger by ~1V than an independent atom approximation, which is attributed to the role of chemical-bonding.

Electron energy loss spectroscopy was employed to determine elastic and inelastic mean free paths at 200 keV. The inelastic MFP was extracted from the log-ratio of zero energy-loss and total transmitted intensities, while the elastic MFP was obtained from the fraction of unscattered electrons within the zero energy-loss signal.

By combining structural, compositional, and electron-optical characterization, this work provides an extensive dataset describing the composition, atomic structure, mean inner potential, and scattering behavior of a-SiN. These parameters can enable calculation of electron propagation through silicon nitride membranes to optimize their use in TEM phase masks, support membranes, and in situ cells.

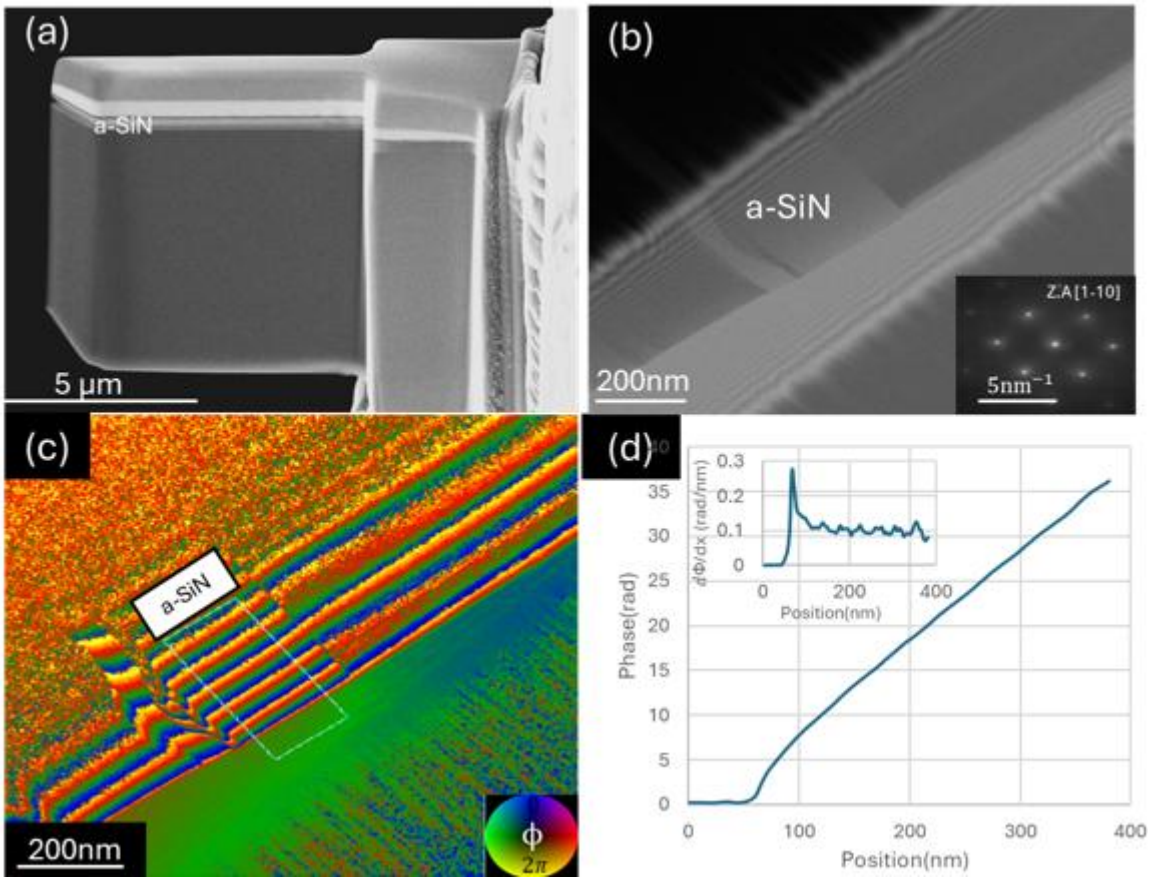


Fig. 1 (a) SE SEM image of a wedge sample prepared in the FIB. (b) Electron hologram of the wedge sample showing the Si substrate, protective layers, and a-SiN layer between them. Inset: Electron diffraction showing that the Si substrate is aligned to the [1-10] zone axis (c) Reconstructed wrapped phase of the electron wave from the hologram. (d) Unwrapped phase profile from the vacuum into the a-SiN layer. Inset: phase gradient showing initial constant gradient up to the distorted edge.

POSTER PRESENTATIONS (Thursday, May 14, 2026 13:00)

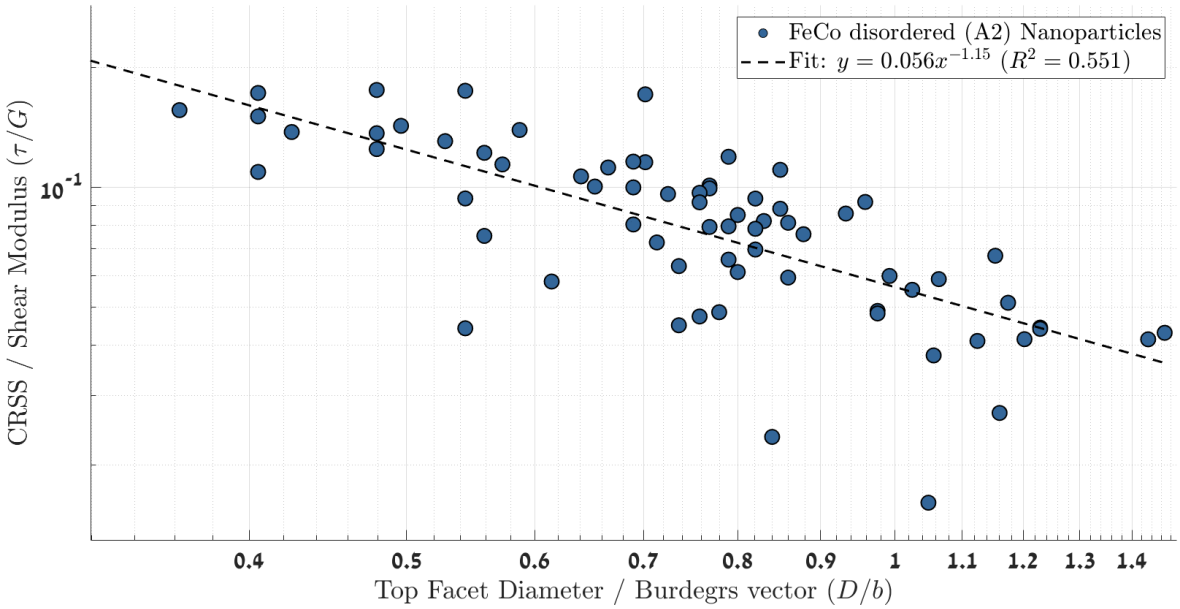
02. Materials Science

P-60

MECHANICAL PROPERTIES OF DISORDERED Fe-Co NANOPARTICLES

Yarden Nathan Yadgar[1]
Materials Science and Engineering, Technion Institue, Israel, Haifa, Israel

We synthesized Fe- 50 at.% Co nanoparticles (NPs) via solid-state dewetting of Fe-Co bilayers deposited on a sapphire substrate at the temperature of 900 ºC followed by slow cooling. By employing X-ray diffraction and electron diffraction in transmission electron microscope (TEM) we demonstrated that the NPs are fully disordered -FeCo body centered cubic (BCC) phase. We demonstrated that the size and orientations of the disordered BCC NPs can be controlled by varying their fabrication parameters. Most of the NPs were faceted single crystals with their top (110) facet oriented parallel to the substrate. The mechanical properties of the NPs were measured by employing in-situ micro compression tests in the scanning electron microscope (SEM). It is shown in the figure below that the "smaller is stronger" pattern in demonstrated according to the hall-patch law. We propose that the fully disordered NPs behave similarly to the defect-free NPs of pure metals. The plasticity of these NPs is controlled by the dislocation nucleation requiring near-theoretical stress. This mechanism explains the near-theoretical strength and the distinct "smaller is stronger" size effect observed in this metastable phase.



POSTER PRESENTATIONS (Thursday, May 14, 2026 13:00)

02. Materials Science

P-61

ENHANCING COMPOSITE MATERIALS PERFORMANCE AT ELEVATED TEMPERATURES USING ATOMIC LAYER DEPOSITION

Eden Elazar[1,2], Tamar Gitli[2], Erez Zemel[2], Tamar Segal-Peretz[1]
[1]*Department of Chemical Engineering, The Technion - Israeli Institute of Technology, Haifa, Israel*
[2]*Rafael - Advanced Defense Systems Ltd., Haifa, Israel*

Composite materials are increasingly used as advanced structural materials in versatile applications, as they offer high specific strength and low weight. However, in applications such as high-speed aviation, where the composite materials are exposed to elevated temperatures and oxidative conditions, their performance is limited. Carbon fibers are susceptible to oxidation-induced degradation at temperatures above 400°C, resulting in reduced mechanical integrity. This research investigates the application of atomic layer deposition (ALD) of metal oxides to improve the thermal and oxidation resistance of carbon fiber-polymer composites.

ALD is a vapor-phase technique capable of depositing uniform, conformal thin films with sub-nanometer precision. In this study, we utilize ALD to achieve uniform coatings on carbon fibers, both in bare form and embedded within a polymer matrix, and probe their mechanical performance at elevated temperatures (300–600°C), with a focus on microscopy-based characterization to resolve coating morphology and uniformity at the nanoscale. We conformally deposited nanometric Al_2O_3 coatings on the carbon fibers, as confirmed by scanning electron microscopy (SEM) and energy-dispersive X-ray spectroscopy (EDS) analysis. Microscopy reveals continuous and conformal coatings along the fiber surface, enabling direct visualization of ALD film coverage on complex geometries. These Al_2O_3-coated fibers showed superior oxidation resistance, characterized via tensile testing and thermogravimetric analysis (TGA).

This work contributes to the development of thermally resilient composite materials and demonstrates the potential of ALD as a surface engineering tool for composites use at challenging environments.

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

03. Frontiers in Instrumentation and Methods

P-62

END-TO-END JOINT OPTIMIZATION OF Z-ENCODING PHASE MASK AND Z-STACK RECONSTRUCTION FOR SINGLE-SHOT 3D FLUORESCENCE MICROSCOPY

Danielle Sapir[1], Ori Rafael Cohen[2], Leen Ileimi[2], Onit Alalouf[2], Yoav Shechtman[1,2]
[1]*ECE, Technion, Haifa, Haifa, Israel*
[2]*BME, Technion, Haifa, Haifa, Israel*

Standard 3D fluorescent microscopy is often limited by slow scanning speeds and susceptibility to photobleaching, while faster volumetric modalities frequently impose prohibitive costs or significant resolution tradeoffs. We propose a scalable solution for snapshot 3D microscopy via the end-to-end joint optimization of an axial-encoding Point Spread Function (PSF) and a deep learning-based reconstruction algorithm. Building on our previous work demonstrating that a Deep Learning method for z-stack reconstruction is capable of restoring some axial range even from standard diffraction-limited images (which contain recoverable axial information via out-of-focus light), this study advances the approach by optimizing fabricable phase masks for superior depth encoding.

Our framework jointly learns the optical element and the reconstruction network. To ensure physical realizability, we optimize the phase mask directly, utilizing a differentiable forward model to extract the resulting PSF at each iteration. The network is initialized with a known z-encoding PSF (e.g., Tetrapod) or an experimentally acquired phase-retrieved mask to inherently account for system-specific aberrations.

To facilitate training without requiring experimental data for every iteration of the evolving mask, we introduce a physics-based data synthesis pipeline. Standard fluorescent z-stacks are processed via a dehazing algorithm to isolate in-focus structures and remove out-of-focus haze. We then simulate the optical system by convolving the dehazed volume with the learned 3D PSF and summing the result, generating a single encoded 2D image. This forward imaging model preserves the visual characteristics of the original optical setup.

Upon convergence, the framework yields a design for a fabricable optical element. Following fabrication, the reconstruction network can be fine-tuned on a small dataset of experimentally captured images to correct for residual fabrication artifacts. Overall, our goal is for this approach to enable robust, single-shot 3D volumetric reconstruction using an optimally engineered depth-encoding phase mask.

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

03. Frontiers in Instrumentation and Methods

P-63

IMAGING ULTRAFAST MODAL ENERGY REDISTRIBUTION IN CSPBBR$_3$ NANOLASERS

Tal Fishman[1], Tetsuro Katayama[3], Tatsuya Fujii[4], Betty Shamaev[2], Yehonadav Bekenstein[2], Ido Kaminer[1]
[1]*Electrical and Computer Engineering (ECE), Technion, Haifa, Israel*
[2]*Materials Science and Engineering (MSE), Technion, Haifa, Israel*
[3]*Institute of Post-LED Photonics, Tokushima University, Tokushima, Japan*
[4]*Graduated school of Science and technology, Tokushima University, Tokushima, Japan*

Nanolasers are emerging as key building blocks for next-generation photonic technologies[1], enabling ultra-compact, ultrafast, energy-efficient light sources for on-chip optical communication, sensing, and quantum information processing. By confining optical modes to deeply subwavelength volumes, nanolasers exhibit enhanced light–matter interaction and reduced lasing thresholds, facilitating integration with nanoscale electronic and photonic platforms. CsPbBr$_3$ have recently emerged as an attractive nanolaser platform, demonstrating record-low lasing thresholds and tunable emission wavelengths[2]. The performance of these devices is governed by the dynamical distribution of hot carriers and their coupling to the spatial energy distribution of cavity modes[3]. Although several techniques probe hot-carrier and photon dynamics in nanolasers, including Kerr-gated time-resolved photoluminescence and transient reflection[3], they do not provide direct access to the spatio-temporal evolution of the energy distribution inside the cavity—information essential for understanding their dynamical behavior.

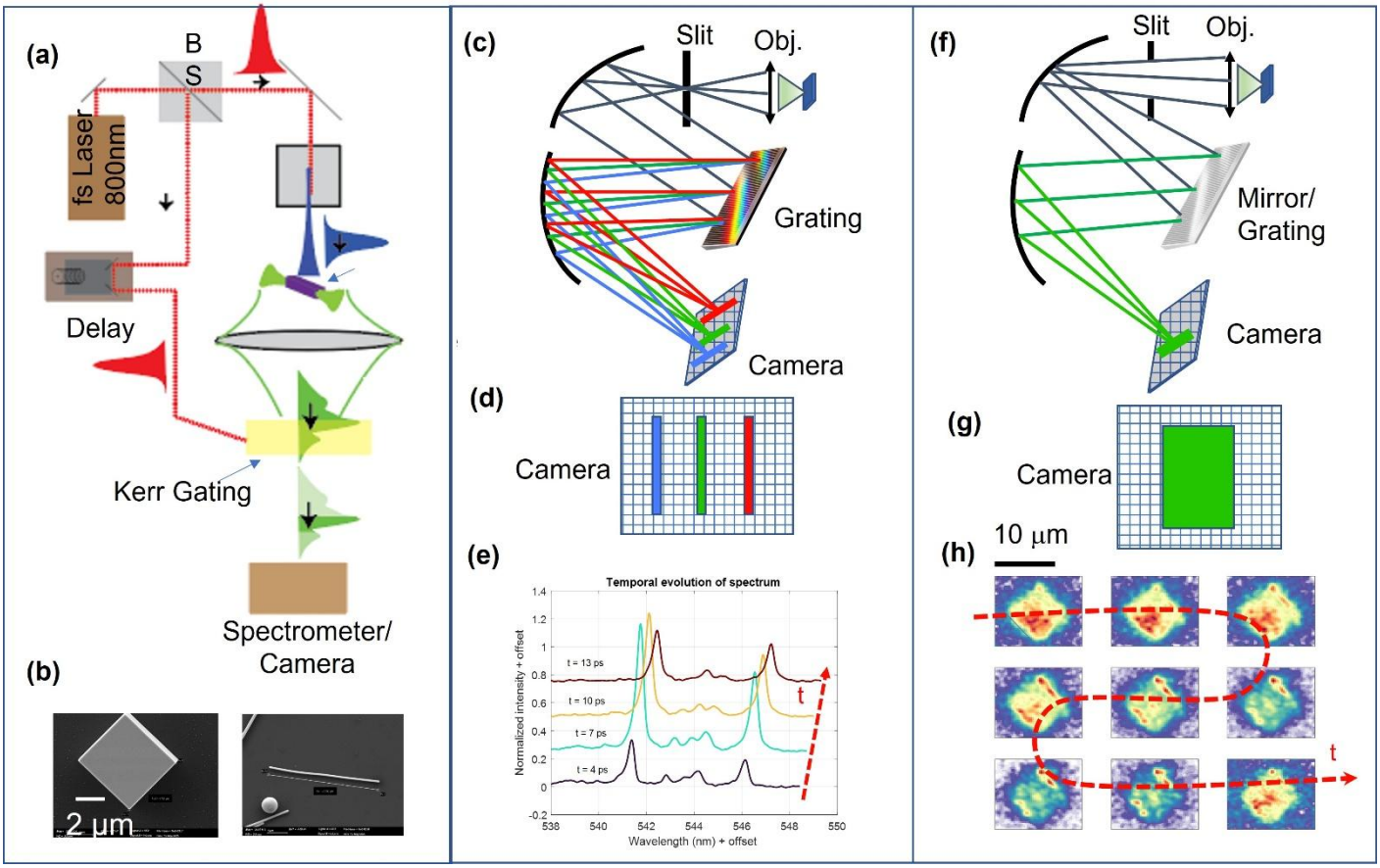
Here we propose a Kerr-gating–based method to image the temporal evolution of the spatial energy distribution inside a nanolaser cavity with sub-picosecond resolution. Unlike conventional Kerr-gated photoluminescence measurements, where the monochromator is used to obtain a time-resolved emission spectrum, our approach uses the Kerr-gated monochromator to directly image the gated emission (Fig. 1a). A 800 nm, 200 fs laser source is used both for excitation (via second-harmonic generation to 400 nm) and for triggering the Kerr-gate, with a controllable delay between pump and gate pulses. In standard Kerr-gated photoluminescence measurements the emission spectrum is recorded as a function of time[3]. The collimated emission (Fig. 1c) impinges on the diffraction grating at a grazing angle, which disperses the spectrum along the horizontal camera axis while each spectral point is averaged along the vertical direction (Fig. 1d). The time-resolved spectrum of a single 7 × 7 μm vapor-phase–synthesized CsPbBr$_3$ nanoplate (Fig. 1b) is shown in Fig. 1e. Each lasing mode appears as a spectral peak (~2 nm separation) whose amplitude and wavelength evolve in time, but this measurement does not reveal the spatial distribution of the modes.

To capture the temporal evolution of the spatial energy distribution, we replace the diffraction grating with an aluminum mirror (Fig. 1f) and adjust the optics so that an image of the gated emission is projected onto the camera (Fig. 1g). The resulting time-resolved spatial energy distribution of the same nanolaser plate is shown in Fig. 1h. At early times the emission is spatially uniform, corresponding to spontaneous emission and weak cavity-mode buildup prior to threshold. As lasing develops, the spatial energy distribution evolves within a few picoseconds due to the ultrashort pump excitation.

Our microscopy approach can also be applied to other light-emitting nanophotonic devices such as LEDs. These previously unobserved ultrafast energy-redistribution dynamics provide new insight into nanolaser operation and may guide the development of improved, lower-threshold electrically driven devices.

References:

1. Nat. Nanotechnol. 14, 12–22 (2019)
2. Nat. Mater. 14, 636–642 (2015)
3. Nat. Commun. 10, 265 (2019)



POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

03. Frontiers in Instrumentation and Methods

P-64

INVERSE-DESIGN OF A SUB-RELATIVISTIC DIELECTRIC LASER ACCELERATOR ON A CHIP

Grigorii Kurnikov[1], Roy Shiloh[1]
The Institute of Applied Physics, The Hebrew University of Jerusalem, Jerusalem, Israel

Is it possible to efficiently accelerate electrons to high energies in just a few hundred microns? One of the most prominent novel accelerator concepts is the dielectric laser accelerator (DLA) that has already demonstrated acceleration gradients on the order of several GeV/m [1] on-chip – far surpassing that of conventional radio-frequency based metallic accelerators. This impressive scale is achieved by employing high-repetition-rate laser pulses at optical wavelengths. To withstand these intense electromagnetic fields, the metal cavities are replaced with nanofabricated silicon structures. Laser light as the driving mechanism allows us to reduce the period of the structure by several orders of magnitude (Fig. 1) with respect to the radio-frequency accelerators. All these attributes have proven successful in recent experiments [2,3] where a beam of electrons, guided through a 0.5mm-long structure, gained about 10.8 keV, corresponding to an average acceleration gradient of 22.7 MeV/m, already on-par with conventional devices.

In this work, we show how a novel optimization concept – namely, the Adjoint Inverse-Design Method [1,4], allows one to control the electron`s spectrum using complex, computer-designed phase-space mechanics to achieve nearly-arbitrary spectral features. Namely, here we pursue an optimal design [5] for a highly-efficient, high-throughput on-chip electron accelerator. This technique enables systematic optimization toward a prescribed acceleration profile, which is the basis of a miniature, table-top solution for on-demand high-energy electrons.

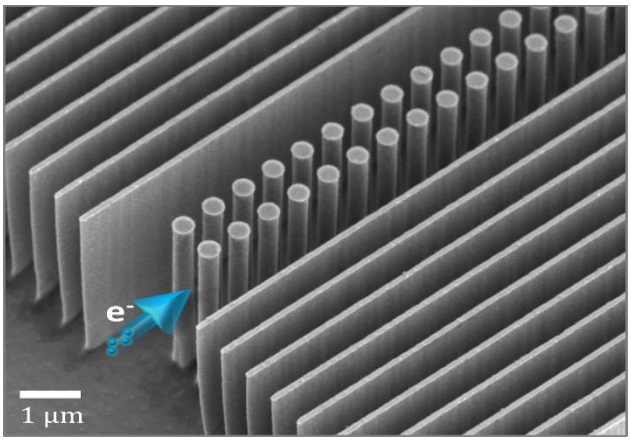


Figure 1: An example of a nano-fabricated dual-pillar structure. Electrons are injected into the pillar colonnade (blue arrow), while laser light drives the structure (not shown). The whole structure is smaller than a grain of sand. Adapted from Opt. Express 29, 14403 (2021).

[1] N. V. Sapra et al., On-chip integrated laser-driven particle accelerator, Science 367, 79 (2020).
[2] R. Shiloh, J. Illmer, T. Chlouba, P. Yousefi, N. Schönenberger, U. Niedermayer, A. Mittelbach, and P. Hommelhoff, Electron phase-space control in photonic chip-based particle acceleration, Nature 597, 498 (2021).

[3] T. Chlouba, R. Shiloh, S. Kraus, L. Brückner, J. Litzel, and P. Hommelhoff, Coherent nanophotonic electron accelerator, Nature 622, 476 (2023).
[4] S. Molesky, Z. Lin, A. Y. Piggott, W. Jin, J. Vucković, and A. W. Rodriguez, Inverse design in nanophotonics, Nature Photon 12, 659 (2018).
[5] T. Hughes, G. Veronis, K. P. Wootton, R. Joel England, and S. Fan, Method for computationally efficient design of dielectric laser accelerator structures, Opt. Express 25, 15414 (2017).

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

03. Frontiers in Instrumentation and Methods

P-65

BRIGHTFIELD SNAPSHOT THREE-DIMENSIONAL MICROSCOPY: TOWARDS IN VIVO IMAGING

Leen Ileimi[1], Yoav Shechtman[1,2]
[1]*Faculty of Biomedical Engineering, Technion, Haifa, Israel*
[2]*Faculty of Electrical and Computer Engineering, Technion, Haifa, Israel*

Background

Three-dimensional (3D) microscopy is essential for resolving complex biological structures, yet conventional microscopes inherently acquire two-dimensional (2D) projections. In brightfield microscopy, 3D imaging is commonly achieved by axial scanning, which limits acquisition speed and may introduce motion artifacts in vivo. Snapshot alternatives avoid scanning but suffer from resolution tradeoffs and reduced field-of-view or sensitivity[1,2]. This work aims to enable snapshot 3D imaging in brightfield microscopy, by jointly encoding depth information through optical point-spread-function (PSF) engineering, traditionally used in fluorescence microscopy, and decoding it using computational reconstruction. The focus is on capillary-like structures in biological environments.

Method

We formulate a Fourier imaging model for partially coherent brightfield microscopy under Köhler illumination to guide PSF engineering. A novel PSF, termed Tripod, is designed to enhance depth encoding for elongated structures. The optical system is implemented experimentally by adapting the illumination and introducing a phase mask in the Fourier plane. To reconstruct volumetric information from a single 2D image, we develop a computational framework that combines a modified Richardson-Lucy deconvolution with neural fields, adapted from prior work[3] in fluorescence microscopy.

Results

Simulations demonstrate that volumetric 3D structure can be reconstructed from a single 2D image using the proposed Tripod PSF. Experimental measurements show that the engineered PSF encodes depth-dependent features in a single snapshot under partially coherent illumination, validating the proposed depth-encoding optical design. Together, these results highlight the feasibility of snapshot volumetric imaging in brightfield microscopy.

Conclusion

This work demonstrates an optical-computational framework for in vivo snapshot 3D imaging in brightfield microscopy, enabling rapid acquisition without axial scanning. PSF engineering, traditionally explored in fluorescence microscopy, is extended here to partially coherent brightfield imaging. Combined with computational reconstruction, this framework enables depth encoding and volumetric reconstruction from a single image.

References:

(1) Levoy, M.; Ng, R.; Adams, A.; Footer, M.; Horowitz, M. Light Field Microscopy. ACM Trans. Graph. 2006, 25 (3), 924–934. https://doi.org/10.1145/1141911.1141976.

(2) Wang, W.; Gong, L.; Huang, Z. Phase-Modulated Multi-Foci Microscopy for Rapid 3D Imaging. Photon. Res. 2024, 12 (7), 1548. https://doi.org/10.1364/PRJ.522712.

(3) Zhang, O.; Zhou, H.; Feng, B. Y.; Larsson, E. M.; Alcalde, R. E.; Yin, S.; Deng, C.; Yang, C. Single-Shot Volumetric Fluorescence Imaging with Neural Fields. Adv. Photon. 2025, 7 (02). https://doi.org/10.1117/1.AP.7.2.026001.

POSTER PRESENTATIONS (Thursday, May 14, 2026 ,13:00)

03. Frontiers in Instrumentation and Methods

P-66

50TH ANNIVERSARY OF THE 6TH EUROPEAN CONGRESS ON ELECTRON MICROSCOPY HELD IN JERUSALEM SEPTEMBER 14-20, 1976

Martin Kessel[1,2,3]
Institute of Microbiology, Hebrew University of Jerusalem, Jerusalem, Jerusalem, Israel
Lab of Cell Biology, National Institutes of Health, National Cancer Institute, Bethesda, Maryland, USA
Visiting Scientist, Chemical and Biological Physics, Weizmann Institute of Science, Rehovot, Israel

The 6th European Congress on Electron Microscopy known as EUREM76 was hosted by the Israel Society of Microscopy in Jerusalem during September 14-20, 1976
In retrospect, 50 years since this pivotal event, we can conclude that hosting a major international meeting was a daring move for such a small local society which had been founded only 12 years earlier in 1964. The driving force behind bringing the congress to Israel was Prof. David Danon from the Weizmann Institute who had 18 years earlier, in 1958, introduced the first transmission electron microscope to Israel at the Weizmann Institute.

David Danon, together with Olga Stein as vice-President, was assisted by an enthusiastic Organizing Committee consisting of Itzhak Ohad, the Hebrew University, as Chair, and Martin Kessel , Hebrew University, as the Organizing Secretary. David Brandon, from the Technion, and Yehuda Ben-Shaul from Tel Aviv University, were the Editors of the handsome two volume Conference Proceedings. Amongst the other members of the committee were Yehuda Marikovsky, Weizmann Institute, who was also the secretary of the Israel Society for Electron Microscopy.

At the 1974 International IFSEM Congress on Electron Microscopy in Canberra, Australia, Martin Kessel, on behalf of ISEM, officially invited the international EM community to come to Jerusalem in1976.

The serious planning for EUREM76 started about two years earlier in 1974 when Kenes was chosen as the congress organizer. The director of Kenes, a new company in this field, was Gidon Rivlin with whom we worked very efficiently. In those pre-internet days all the scientific conference correspondence was typed by hand using carbon copies and we relied on regular postal mail. Much of this secretarial work was done out of Martin Kessel's home with my then wife, Judy Kessel, doing a heroic job of all the typing.

The newly constructed Binyanei Ha'Ooma in Jerusalem was chosen as the conference site. The 1976 conference turned out to be very innovative in that the program consisted of Symposia with invited talks only, and all the other communications were presented as posters. This was clearly a gamble but turned out to be highly successful

In later years, and even today, it is quite amazing to meet scientists who were at the beginning of their careers at the time of the conference in Jerusalem and who today are leaders in the field. Knut Urban, Harold Rose, **Ueli Aebi**, Jacques Dubochet (2017 Nobel Laureate in Chemistry), Dan Shechtman (2011 Nobel Laureate in Chemistry), Jorg Kistler, **Andreas Engel**, Manfred Ruhle, Ruth Sperling, Bob Josephs, **Eduard Kellenberger**, **Kevin Leonard**, David Eisenberg, Ondrej Krivanek, Peter Rez. Joachim Frank,

(2017 Nobel Laureate in Chemistry) submitted two abstracts to the Conference but was unable to attend himself.
For the intervening conference Shabbat we organized Home Hospitality on Friday night. This turned out to be a resounding success with some 200 congress participants being hosted at their homes by many members of the Israel Society in Jerusalem, Rehovot, Tel Aviv and Haifa.

At the Jerusalem conference the Committee of European Societies for Electron Microscopy (CESEM)was formalized.
http://www.ismicroscopy.org.il/history/#EM76

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

03. Frontiers in Instrumentation and Methods

P-67

AUTOMATED CRYSTAL ORIENTATION MAPPING ACROSS DIFFERENT COCCOLITHS USING 4D-STEM

Rebecca Leghziel[1], Lia Addadi[1], Assaf Gal[1], Lothar Houben[1]
Plant and Environmental Sciences, Weizmann Institute of Science, Rehovot, Israel, Israel

Coccoliths are complex biomineral structures produced by unicellular algae, composed of a radial array of 20–50 interlocking calcite crystals. The general principles governing crystal arrangement appear to be similar: crystals orient themselves with quasi-vertical (V-units) and quasi-radial (R-units) directions relative to the organic matrix. [1] While these observations suggest that the fundamental organization of the crystals may be conserved, coccolith morphology varies widely across species.

We developed a computational pipeline designed to extract crystal orientations and segment the different crystalline units within the individual coccoliths. Our approach relies on four-dimensional scanning transmission electron microscopy (4D-STEM), in which a two-dimensional diffraction pattern is recorded at every probe position, producing a four-dimensional dataset. By associating a diffraction pattern with each pixel in real space at nanometer resolution, individual crystal units can be isolated and their spatial orientation determined. Our computational pipeline is designed to operate robustly across coccoliths from different species, enabling consistent comparative and statistical analysis. [2]

Using this approach, we reconstruct crystallographic orientation maps for coccoliths from three different species. These datasets enable the construction of quantitative models of coccolith crystal architecture and reveal both conserved and species-specific structural features.

[1] Young, Jeremy R., et al. "Crystal assembly and phylogenetic evolution in heterococcoliths." Nature 356.6369 (1992): 516.

[2] Rebecca C Leghziel, Lia Addadi, Assaf Gal, Lothar Houben, Solving the Crystal Architecture of Coccoliths Using 4D-STEM, Microscopy and Microanalysis, Volume 31, Issue 5, October 2025, ozaf087

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

03. Frontiers in Instrumentation and Methods

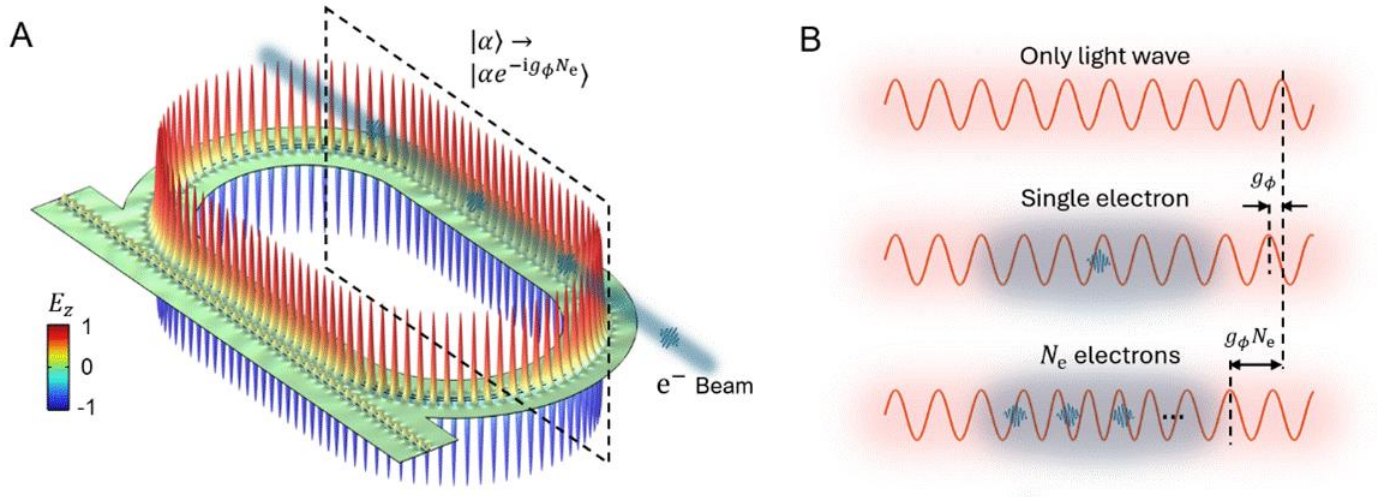
P-68

ELASTIC QUANTUM COUPLING BETWEEN FREE ELECTRONS AND PHOTONS

Dingguo Zheng[1], Ofer Kfir[1]
School of Electrical Engineering, the Iby and Aladar Fleischman Faculty of Engineering, Tel Aviv University, Tel Aviv, Israel

Recent years saw a rising interest in the coupling of electrons and photons in electron microscopes [1–5]. These include either stimulated processes using lasers as classical light, or spontaneous driven by photonic vacuum fluctuations. However, the quantum framework for such coupling included only inelastic processes, where elastic phenomena considered only for multi-photon states, not accounting for the role of the vacuum.

Here, we present a quantum optical framework for the elastic coupling between free electrons and photons. Essentially, the elastic coupling is governed by the scattering operator, $S=\exp(-ig_{\Phi}N_eN_{ph})$, where g_{Φ} is the elastic coupling parameter and N_e (N_{ph}) is electron (photon) number operator. We demonstrate that the laser manipulation of electron beams is accompanied by a quantum back-action, which induces a small but measurable phase shift on the interacting photonic mode. Fig. 1 illustrates an exemplary system to observe the effect. The electron traversing the optical field imprints a phase shift $\Delta\Phi=-g_{\Phi}N_e$, on the confined photonic mode. The induced phase shift scales linearly with the number of free electrons, which can be quantified as an effective, birefringent refractive index of a free electron.



Crucially, our analysis formulates this elastic interaction as a dispersive Hamiltonian. Because this interaction commutes with the undisturbed system, it preserves the initial electron state up to a pure phase. This dynamic satisfies the conditions for Quantum Non-Demolition (QND) measurements [6], allowing for the precise counting of electrons in a beam without destroying their quantum state. To observe this effect, we propose an experimental architecture that integrates an optical racetrack microresonator within the vacuum chamber of an electron microscope. The transient phase shift in the resonator induced by a traversing electron translates into a measurable dynamic variation in the resonator`s out-coupled optical energy, thereby providing a good quantum number estimator for electron number.

Harnessing this state-preserving, elastic interaction provides a novel pathway to generate sub-Poisson multi-electron states. Ultimately, QND electron counting approaches the limit of generating pure electron-number states, promising enhanced signal-to-noise ratios beyond the standard quantum limit and enabling true sub-shot-noise quantum sensing and holographic imaging down to the atomic scale.

References

[1] O. Kfir, Entanglements of Electrons and Cavity Photons in the Strong-Coupling Regime, Phys. Rev. Lett. 123, (2019).

[2] V. Di Giulio and F. J. García De Abajo, Free-electron shaping using quantum light, Optica 7, 1820 (2020).

[3] R. Dahan et al., Imprinting the quantum statistics of photons on free electrons, Science 373, (2021).

[4] A. Preimesberger, S. Bogdanov, I. C. Bicket, P. Rembold, and P. Haslinger, Experimental Verification of Electron-Photon Entanglement, arXiv:2504.13163.

[5] J.-W. Henke, H. Jeng, M. Sivis, and C. Ropers, Observation of Quantum Entanglement between Free Electrons and Photons, arXiv:2504.13047.

[6] P. Grangier, J. A. Levenson, and J.-P. Poizat, Quantum non-demolition measurements in optics, Nature 396, 537 (1998).

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

03. Frontiers in Instrumentation and Methods

P-69

A NEW LOOK AT DARK-FIELD TEM ORIENTATION MAPPING: AN EFFICIENT SOLUTION FOR CHARACTERIZATION OF NANOCRYSTALLINE MATERIALS

Anastasiya Reveguk[1], Amram Azulay[1], Ilan Goldfarb[1], Amit Kohn[1]
Department of Materials Science and Engineering, The Iby and Aladar Fleischman Faculty of Engineering, Tel Aviv University, Tel Aviv, Israel

4D-STEM is adopted widely for mapping of crystal orientation (1) by recording an entire diffraction pattern at each probe position. However, it requires specialized hardware, large datasets, and the spatial resolution in parallel-beam mode is limited to several nanometers (2). Acquisition times further restrict map size, which forces a trade-off between spatial-resolution and field of view. For nanocrystalline materials, where both sampling statistics and spatial resolution are critical, these limitations can be prohibitive.

Dark-field TEM orientation mapping, first proposed by Dingley and Nowell (3), offers an alternative by controlled beam tilting in conical coordinates using a small objective aperture. Previously (4, 5), reciprocal space was sampled on a uniform grid, producing thousands of images. These images were analyzed by template-matching, which is computationally expensive and therefore limited to low-resolution images and coarse angular sampling.

We propose analyzing the conical dark-field dataset in the native polar coordinates of both the acquisition geometry and the diffraction rings, rather than by conventional template matching. Beam tilt is parameterized by the scattering vector magnitude, k, corresponding to a specific Debye ring and azimuthal angle, φ, along that ring. A 10 μm objective aperture is used resulting in ~1 nm real-space resolution. For a given k, the φ-dependent dark-field intensity profile at each pixel is extracted along a selected ring.

Mapping approaches are presented and compared, based on azimuthal dark-field intensity profiles along single or multiple rings. We examine sensitivity to orientation and identification of grains. This identification enables automated analysis of grain size-distribution. The full conical dark-field dataset is preserved, so single-pixel diffraction analysis or template matching are accessible when needed.

Our proposed method is computationally lightweight, operates on standard TEMs, and yields large-field-of-view orientation maps at high spatial resolution, making it well-suited for characterization of nanocrystalline materials.

References:

1. C. Ophus, Microanal. 25, 563–582 (2019).
2. E. Drouillas, J.-G. Mattei, B. Warot-Fonrose, Micron. 190, 103785 (2025).
3. D. J. Dingley, M. M. Nowell, Microchim. Acta. 147, 157–165 (2004).
4. D. J. Dingley, Microchim Acta. 155, 19–29 (2006).
5. G. Wu, S. Zaefferer, Ultramicroscopy. 109, 1317–1325 (2009).

POSTER PRESENTATIONS (Thursday, May 14, 2026, 13:00)

03. Life Sciences:

P-70

DISPERSED RELEASE OF LYTIC GRANULES BY CAR-T CELLS LEADS TO DISTANT AND WIDE-SPREAD KILLING OF TARGET CANCER CELLS

Amit Ifrach [1] , Julia Sajman [1,2] , Oren Yakovian 1 , Eman Gharra [3] , Yariv Greenshpan [3], Angel Porgador [3] , Eilon Sherman [1*]

1 Racah Institute of Physics, The Hebrew University, Jerusalem, Israel, 91904
2 Jerusalem College of Technology, Jerusalem, Israel 91160
3 The Shraga Segal Department of Microbiology, Immunology, and Genetics, Faculty of Health Sciences, Ben-Gurion University of the Negev, Beer-Sheva, Israel
** - corresponding author*

Cytotoxic T cells (CTLs) and Chimeric Antigen Receptor T cells (CAR-Ts) mediate target cell killing by releasing lytic granules that contain granzymes and perforin. Despite their significance, these release and killing processes remain poorly understood in both CTLs and CAR-Ts due to spatiotemporal limitations in imaging the immune synapse (IS) and the transient contacts of these T cells with their targets. Here, we employed high and super-resolution microscopy in controlled geometries, to study the killing mechanism induced by the release of lytic granules by CTLs and anti-HER2 CAR-Ts. Surprisingly, we found that CAR-Ts could kill from a distance up to 60um. Distant killing depended on CAR activation and was mediated by wide-spread and prolonged release of lytic granules, as the CAR-Ts could not form a mature synapse with a distinct secretory synaptic cleft. Distant killing can promote effective tumor clearing by CAR-Ts yet may also harm neighbouring healthy tissues. Thus, this process should be considered in CAR-T and related CTL-mediated immunotherapies.

Index by Topic

01. Life Sciences

02. Materials Science

ENHANCING COMPOSITE MATERIALS PERFORMANCE AT ELEVATED TEMPERATURES USING ATOMIC LAYER DEPOSITION (P)

03. Frontiers in Instrumentation and Methods

END-TO-END JOINT OPTIMIZATION OF Z-ENCODING PHASE MASK AND Z-STACK RECONSTRUCTION FOR SINGLE-SHOT 3D FLUORESCENCE MICROSCOPY (P)

IMAGING ULTRAFAST MODAL ENERGY REDISTRIBUTION IN $CSPBBR_3$ NANOLASERS (P)

INVERSE-DESIGN OF A SUB-RELATIVISTIC DIELECTRIC LASER ACCELERATOR ON A CHIP (P)

BRIGHTFIELD SNAPSHOT THREE-DIMENSIONAL MICROSCOPY: TOWARDS IN VIVO IMAGING (P)

50TH ANNIVERSARY OF THE 6TH EUROPEAN CONGRESS ON ELECTRON MICROSCOPY HELD IN JERUSALEM SEPTEMBER 14-20, 1976 (P)

AUTOMATED CRYSTAL ORIENTATION MAPPING ACROSS DIFFERENT COCCOLITHS USING 4D-STEM (P)

ELASTIC QUANTUM COUPLING BETWEEN FREE ELECTRONS AND PHOTONS (P)

A NEW LOOK AT DARK-FIELD TEM ORIENTATION MAPPING: AN EFFICIENT SOLUTION FOR CHARACTERIZATION OF NANOCRYSTALLINE MATERIAL (P)

Life Sciences:

DISPERSED RELEASE OF LYTIC GRANULES BY CAR-T CELLS LEADS TO DISTANT AND WIDE-SPREAD KILLING OF TARGET CANCER CELLS(P)

Performance meets practicality

Drop by our booth at ISM and discover how the new Thermo Scientific™ Glacios™ 3 cryo-TEM with Thermo Scientific READY™ environmental protection system is delivering cryo-EM to more spaces and more researchers.

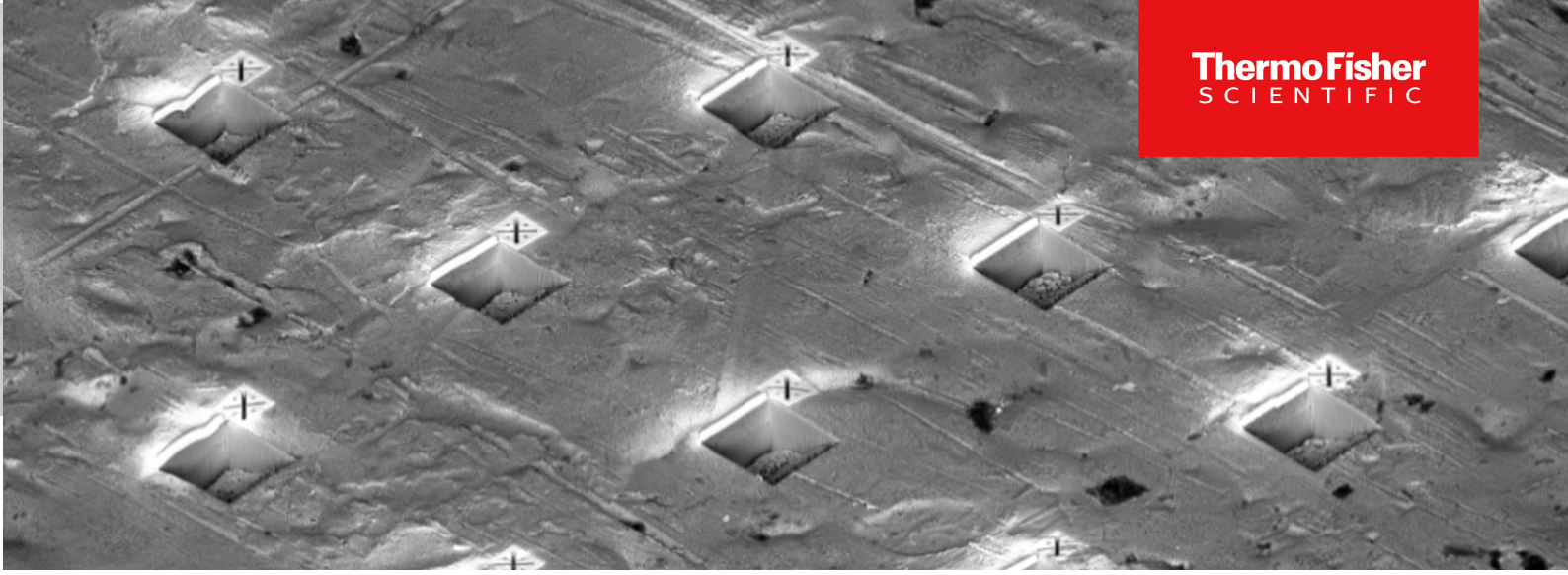
Learn about innovative new features including optical improvements that:

- Increase data yield per image
- Reduce data storage demands
- Enhance usability.

Learn more

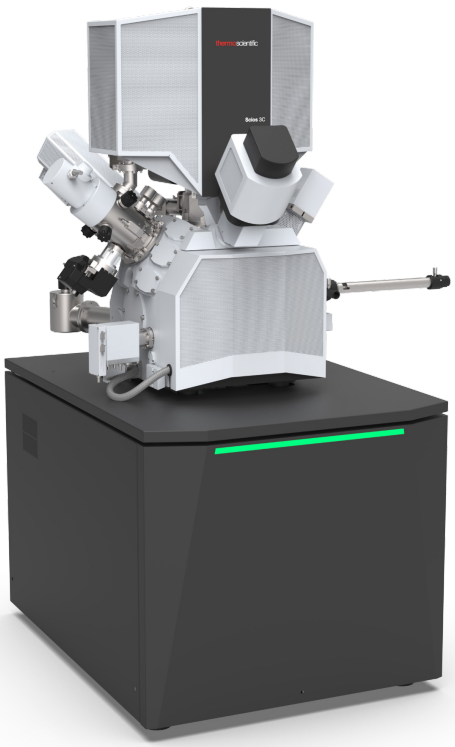
Learn more at **thermofisher.com/glacios**

thermo scientific



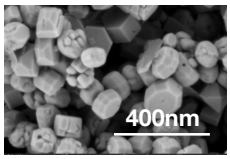
Scios 3 FIB-SEM

Maximum Performance with Application Versatility

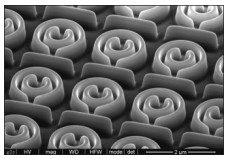


Thermo Scientific™ Scios™ 3S FIB-SEM

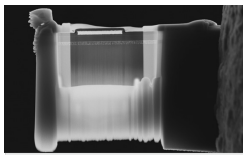
- Highest quality S/TEM sample prep
- Accessibility to high quality
- Superior contrast UHR imaging
- Fully configurable to address any materials challenge
- Complete analytical platform



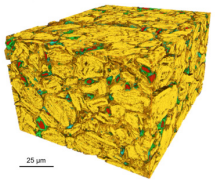
Ultra-High Resolution Imaging



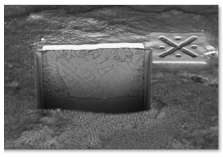
Nanopatterning



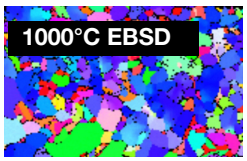
TEM Sample Preparation



3D Characterization



Cross-Sectioning



In Situ Characterization

To learn more, visit **thermofisher.com/Scios3**

thermo scientific

WANT KNOW MORE ABOUT OUR SEM & TEM SOLUTIONS?

מוזמנים להגיע לפגישה עם הדוגמאות שלכם או
להצטרף לאחד מימי העיון וה-WORKSHOPS
עם ד"ר עמרי דביר, <u>ללא תשלום</u>

ברגל ציוד אנליטי

SALES@BARGAL.CO.IL 03-9796533

JEOL

BARGAL
ציוד אנליטי

ALL YOUR NEEDS FOR YOUR ELECTRON MICROSCOPY LAB

- TEM
- Cryo TEM
- SEM
- Sample preparation
- Detectors
- Cameras
- Consumables

מוזמנים להגיע לפגישה עם הדוגמאות שלכם או להצטרף לאחד מימי העיון וה-WORKSHOPS עם ד"ר עמרי דביר, <u>ללא תשלום</u>

ברגל ציוד אנליטי

SALES@BARGAL.CO.IL 03-9796533

JEOL

OXFORD INSTRUMENTS

Quantum DETECTORS

Quorum

GATAN AMETEK

agar scientific

BARGAL
ציוד אנליטי

APPLIED MATERIALS™

Applied Materials Israel is a Proud Sponsor of ISM Meeting 2026

Applied Materials Israel is home to the most advanced semiconductor manufacturing Process Diagnostics and Control technologies. Based in Rehovot, we develop, manufacture and market cutting-edge optical and electron-beam based microscopes for semiconductor metrology and wafer defect inspection. Our optical based microscopes use deep-ultra-violet light for high resolution imaging, and our electron beam based microscopes enable nanometer scale resolution metrology of most advanced electronic devices. We use deep learning, computer vision, AI and advanced algorithms to develop our **state-of-the-art semiconductor metrology and wafer inspection systems** that play a crucial role in the manufacturing of the most advanced chips.

Our systems enable our customers to transform possibilities into reality.

We are hiring for multiple R&D positions - Physicists, Hardware Engineers, Algorithms developers, Software Engineers, System Engineers and more.

You can explore our open positions
and upload your CV here-

APPLIED MATERIALS™

Applied Materials Israel eBeam Horizon Program

In 2025 we launched our **eBeam Research Grants Program – eBeam Horizon**, designed to stimulate and foster applied academic research on electron beam technologies in Israel. This program is part of our continuous commitment and efforts to pushing the boundaries of eBeam knowledge and creating a sustained research ecosystem in Israel.

Our vision is to establish a sustained Applied Materials Israel-Academic research program focused on eBeam technologies in Israel. The program is designed to create a long-term and continuous dialogue between industry and academia researchers and students. This initiative will strengthen the Israeli academia eBeam ecosystem, benefiting both the Israeli industry and academia in the long run.

We invite researchers and students to join us in this exciting venture, where innovation meets opportunity. Together, we will expand the boundaries of eBeam technologies, paving the way for scientific explorations and commercial technology applications.

The first call for proposals for the program is now closed. Four eBeam research proposals by researchers from Tel-Aviv University, Hebrew University and the Technion were selected in 2025. Information on the next call for proposals will be announced in the future.

You can read more about the program here-

or reach out to us directly at
ebeam_horizon@amat.com