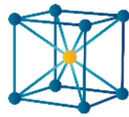


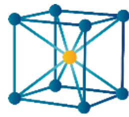
ISM2026 - Pre-Meeting Workshop

"Analytical Electron Microscopy"

Department of Materials Science & Engineering,
Technion - Israel Institute of Technology, Haifa
David Wang Auditorium, Dalia Maydan Bldg. 3rd floor

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** / 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** / 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**			



ANALYTICAL ELECTRON MICROSCOPY FOR MATERIALS SCIENCE: GOING BEYOND COMPOSITION ALONE

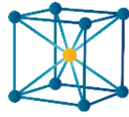
Wayne D. Kaplan

Department of Materials Science and Engineering
Technion – Israel Institute of Technology

Analytical electron microscopy includes a powerful set of techniques for determining qualitative and quantitative chemical information within the electron microscope. In the scanning electron microscope (SEM), these techniques include energy dispersive X-ray spectroscopy (EDS) and wavelength dispersive spectroscopy (WDS). In the scanning/transmission electron microscope (S/TEM), analytical methods include EDS from thin foils and electron energy loss spectroscopy (EELS).

Yet analytical electron microscopy offers much more than simply identifying which elements are present and measuring their local concentrations. Increasingly, these methods are being used to reveal deeper material insights, including valence states, local electronic structure, and Gibbsian excess at free surfaces, interfaces and grain boundaries.

This tutorial will provide an accessible overview of what can be achieved using EDS and WDS in both the SEM and S/TEM, with an emphasis on practical approaches for obtaining results that are as quantitative, reliable, and straightforward as possible. The goal is to highlight not only the capabilities of these methods, but also how they can be used to answer important materials science questions that go well beyond composition alone.

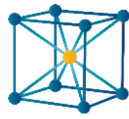


STATISTICAL ASPECTS IN ANALYTICAL EM

Alex Berner

Department of Materials Science and Engineering
Technion - Israel Institute of Technology

Repeatability of X-ray intensity measurements will be considered based on Poisson statistics. Formulas for estimation and prediction of limit of element detection for EDS/WDS/SEM and EDS/TEM will be derived. Optimal analytical conditions for the minimization of detection limits will be found. Quantitative determination of a degree of compositional non-uniformity in solid solutions will be considered.

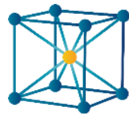


EELS IN THE TEM: FUNDAMENTALS, MODERN TOOLS AND APPLICATIONS BEYOND ELEMENTAL ANALYSIS

Lothar Houben

Weizmann Institute of Science

Electron energy-loss spectroscopy (EELS) in the transmission electron microscope (TEM) provides rich insight into the composition and electronic structure of materials. This contribution introduces the fundamental principles of EELS and highlights how recent advances in instrumentation expand its capabilities. In particular, direct electron detection enables enhanced sensitivity and improved signal-to-noise, allowing reliable low-dose measurements for beam-sensitive systems. Application examples include monochromated EELS for probing optical excitations and fast, low-dose core-loss EELS for accessing bonding and electronic structure. Together, these approaches demonstrate how modern EELS enables the study of materials properties well beyond elemental analysis.



ATOM PROBE TOMOGRAPHY FOR ELEMENTAL ANALYSIS

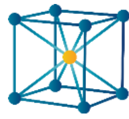
Yaron Amouyal

Department of Materials Science and Engineering
Technion – Israel Institute of Technology

Atom Probe Tomography (APT) is a powerful materials characterization technique that provides three-dimensional imaging of sub-micron samples with nearly atomic resolution and enables precise quantification of low-concentration species (<100 at. ppm) distributed across nanometer-scale distances and embedded within complex spatial morphologies. When combined with electron microscopy, APT has become an exceptionally versatile tool for addressing fundamental questions in materials science, particularly in metallic, ceramic, and semiconducting systems, with some recent extension of its capabilities toward soft and molecular materials.

We will briefly outline the physical principles of laser assisted, local electrode APT, with particular attention to the factors that govern the accuracy of elemental quantification. We will then introduce our new LEAP® 6000 XR system, which features a deep UV laser, an energy compensated electrostatic lens, and an optional synchronous laser plus voltage pulsing mode. Together, these advances substantially narrow spectral peak widths, enhance the signal to noise ratio, and reduce the incidence of multiple events. As a result, the system delivers markedly improved reliability in the measurement of low concentration species, enabling more robust and confident compositional analysis at the atomic scale.

We view the establishment of the Israel Center for APT as an important milestone in advancing the field of materials characterization in Israel, and we warmly invite the research and industry communities to engage with the center and make full use of its capabilities and services.



CATHODOLUMINESCENCE IN SEM - RESEARCH AND APPLICATION

Zahava Barkay

Tel-Aviv University

Cathodoluminescence (CL) in the scanning electron microscope (SEM) constitutes a powerful platform for nanoscale optical characterization. Conventionally, SEM-CL has been employed for wavelength-resolved spectroscopy, enabling the identification and analysis of impurities and defect states at parts-per-million (ppm) concentrations.

Here, we report advanced CL methodologies, including hyperspectral imaging, nanoscale resonance mapping with spatial resolution approaching 10 nm, and angle-resolved emission measurements. We further demonstrate optical band structure characterization via energy–momentum (E–k) dispersion analysis, along with polarization-resolved and time-resolved second-order correlation (g^2) measurements.

The results presented here underscore our laboratory's capabilities in nanophotonics, with particular emphasis on recent studies of plasmonic nanostructures, photonic crystals, and electron-beam-driven light emission phenomena, including the Smith–Purcell effect.