



POSTER #21

SYNTHESIS OF CRYSTALLINE, 2D LAYERED, COPPER SULFIDE USING CHEMICAL VAPOR DEPOSITION (CVD)

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Copper sulfide, which has been extensively researched, is a p-type semiconductor with a 1.5-2.5 eV bandgap, it exhibits promising thermo-electric properties, and has been mostly used for harvesting light in photovoltaic devices. Using a simple chemical vapor deposition (CVD) process, we synthesized large samples of layered-crystalline copper sulfide. By exposing copper foil to an atmosphere containing sulfur in 650°C, we transformed the metallic copper into copper sulfide in a one-step anneal under inert gas flow. Using scanning electron microscopy (SEM), we observed morphologies with three fold symmetry and specific orientations (Figure 1). XRD characterizations indicated the copper sulfide obtained has an atomic ratio of Cu_9S_5 in two phases, a rhombohedral phase and a cubic one. HRTEM and atomic force measurements (AFM) showed that the synthesized copper sulfide is a layered material and that we were able to isolate single layers. By electron transmission microscopy (TEM) with converged beam electron diffraction (CBED) characterization we were able to correlate the layered phase with a rhombohedral crystal structure (Figure 2). We are currently exploring the specific electrical properties of this layered compound.

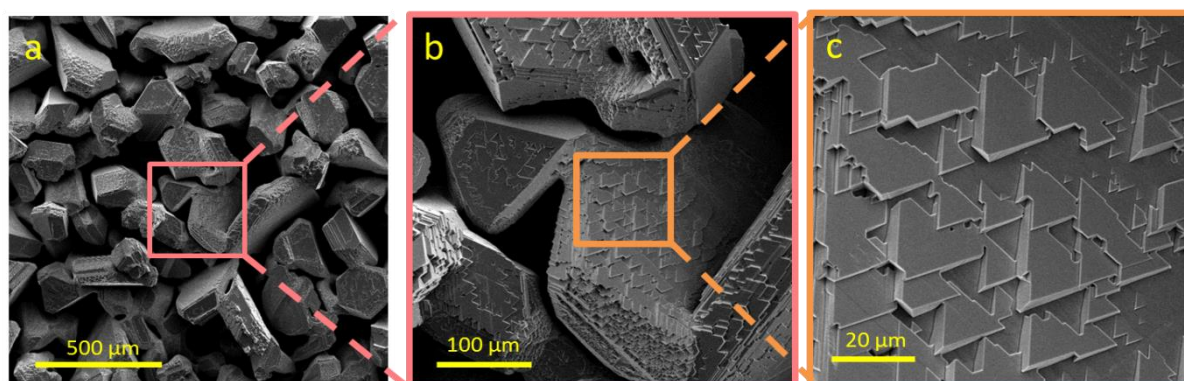


Figure 1. SEM images of layered $\text{Cu}_{1.8}\text{S}$: (a) low magnification presents sub-millimeter sized crystallites; (b) further magnification resolves layered texture of 2D triangles; and (c) all triangles are in perfect stoichiometric relations suggesting that the millimeter-sized grains are single crystals.

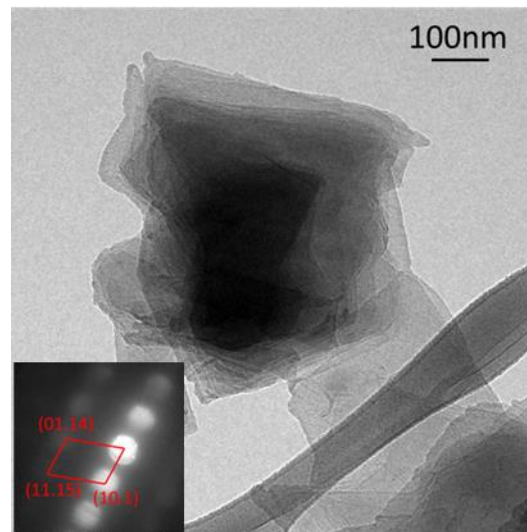


Figure 2. TEM image and CBED analysis confirm the layered copper sulfide as being a rhombohedral Cu_9S_5 phase.