Online Proceedings

POSTER SESSION 2

Balcony, Easel 102

1:00 PM to 2:30 PM

Anhydrous, Oxygen-Free Electrochemical Synthesis of Germanium Nanowires

Benedicte Makinu Diakubama, Junior, Chemical Engineering
Mentor: Grant Williamson, Molecular Engineering
Mentor: Vincent Holmberg, Chemical Engineering

The electrochemical growth of single-crystalline germanium (Ge) nanowires has been previously demonstrated in an aqueous solution for use in complementary metal oxide semiconductor (CMOS) technologies. The motivation for growing these nanowires using electrodeposition is to improve the purity of germanium nanowires relative to traditional synthetic methods. However, nanomaterial growth has been shown to be highly sensitive to both oxygen and water and can lead to impurities, surface layers or morphology changes. . We have grown germanium nanowires in anhydrous organic solution in a nitrogen blanketed electrochemical cell. We have then compared the morphology and material properties of the wires grown in aqueous solution to the wires grown in organic solution to determine the effects of water and oxygen on the wire growth. Improving nanomaterial growth will help in having more efficient computers and cell phones by improving semiconductors.

POSTER SESSION 4

Commons West, Easel 27

4:00 PM to 6:00 PM

Synthesis and Optical Response of High Quality CuFeS2 Nanocrystals

Srivathsav (Sri) Venkatesh, Senior, Chemical Engr: Nanosci & Molecular Engr
Mentor: Vincent Holmberg, Chemical Engineering
Mentor: Soohyung Lee, Chemical Engineering

Chalcopyrite copper iron sulfide (CuFeS2) nanocrystals have gained recent interest due to their metal-like optical response, despite their complete lack of free charge carriers. These novel optical characteristics make CuFeS2 an intriguing material for a variety of applications, including photovoltaics and photothermal applications. Unfortunately, synthesis of high quality CuFeS2 nanoparticles is difficult due to the difference in the reactivity of the two cations, often resulting in binary or polydisperse nanocrystals. To gain better control over nanocrystal morphology, we synthesized CuFeS2 nanocrystals via a hot injection method and studied the effect of the cation precursor ratio on the resulting properties of the nanocrystals. Transmission electron microscopy, X-ray diffraction, and UV-vis-NIR spectroscopy were used to analyze the nanocrystal composition, morphology, and optical characteristics. Based on the characterization data, a 1:2 molar ratio of copper to iron precursor was optimal for producing high quality, monodisperse CuFeS2 nanocrystals. These developments in morphological control will aid in future studies of quasi-static resonances in these materials.

POSTER SESSION 4

Commons West, Easel 26

4:00 PM to 6:00 PM

AFM-Based Imaging of High-Capacity Nanowire Conversion-Type Li-Ion Battery Negative Electrodes

Chester T. Pham, Senior, Chemical Engr: Nanosci & Molecular Engr
NASA Space Grant Scholar
Mentor: Vincent Holmberg, Chemical Engineering
Mentor: Grant Williamson, Molecular Engineering

Nanowires have shown significant promise as high-capacity, conversion-type lithium-ion battery negative electrodes. Investigating the local properties of these materials during cycling has primarily been done via in-situ transmission electron microscopy or synchrotron-based techniques. Both techniques require highly specialized equipment that is not readily available. Atomic force microscope (AFM)-based measurements of electronic and ionic transport offer another alternative. However, analyzing these electrode materials via AFM has proven difficult due to the large surface variations in Z-height and the flexibility of the wires, which can trap and damage AFM tips. Therefore, sample preparation becomes critical. In this study we screened a variety of preparation methods including epoxies and resins and from those results, determined successful methods to prepare and ultramicrotome samples to create thin slices of electrode that can support analysis via AFM. These images allow for the elucidation of surface characteristics to support future surface functionalization and show that AFM can be applied to the imaging of these types of electrode materials to obtain nanoscale properties. A stronger understanding of local properties in these materials is critical to future developments that are highly anisotropic and require nanostructures.