Inorganic Chemistry Seminar

Prof. Kaner Group

Lisa Pangilinan

"Effects of Solubility and Grain Size Refinement on the Hardness of Transition Metal Borides"

Abstract: The search for novel superhard materials is motivated by the demand for alternatives to current tools and abrasives in the machining and manufacturing industries. Inspired by the high bond covalency and superior hardness of diamond, the hardest known material to date, our group has produced a wide range of superhard metal boride systems and their solid solutions by combining incompressible transition metals with short boron-boron bonds. In this study, we demonstrate the ability to enhance bulk material hardness of MB_2 systems (M = Re, W) through mechanisms such as solid solution strengthening, grain size refinement, and precipitation hardening. These studies have resulted in new materials with enhanced hardness and oxidation resistance. Using the solubility and hardness data from this work in conjunction with other systems previously studied in our group, we have formulated a collective library of crystal structures and metal atom substitutions. Understanding the solubility and hardness trends of these systems offers the potential for a targeted approach towards designing new materials with increased hardness and controlled grain morphology.

Mit Muni

"Graphene for Capacitive Energy Storage"

Abstract: Graphene, a single sheet of graphitic carbon, has been a revolutionary material due to its high theoretical surface area and electrical conductivity. The combination of the high surface area and conductivity can allow for large amounts of charge to be stored while having the ability to charge and discharge very quickly. Previously, we have developed a method to fabricate graphene via laser reduction of graphene oxide (LRGO). Here, we utilize carbon nanodots (CNDs) and ferrocene to increase the performance of LRGO supercapacitors. Biomolecule-based CNDs, which are synthesized by microwave-assisted thermolysis of citric acid and urea, can be converted into open porous 3D graphene networks by irradiation with a laser. The CNDs can act to patch defects in graphene, demonstrating a fast response for AC-line filtering applications. Additionally, a graphene/ferrocene redox active 3D composite supercapacitor will be discussed. The combination of highly reversible, conductive and strongly attached ferrocene with the high surface area and open porous structure of graphene results in high-power, high-energy density supercapacitors.

Wednesday, June 2nd 2021

4:00 p.m. | Via Zoom

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