Intercalation, Oxidation, and Bond Formation in Metal Chalcogenides

Kirill Kovnir
Professor of Chemistry, Iowa State University and
Ames National Laboratory, U.S. Department of Energy, Ames

Chemistry Seminar on the Chemistry of Chalcogenides

Monday October 13 at 4 pm in 126 Schrenk

Please contact Dr. Amitava Choudhury at choudhurya@mst.edu for further information.

MISSOURI S&T

Abstract: 1D or 2D metal chalcogenide exhibit a plethora of interesting properties ranging from magnetism and superconductivity to catalysis. We developed hybrid compounds composed of infinite 1D or 2D iron-chalcogenide fragments and 0D coordination complexes. In this way the magnetic interactions and tunability can be segregated into two different sublattices of a hybrid material. Utilizing coordination chemistry methodology to tune the molecular amine complexes we can manipulate the composition structure and properties of the hybrid materials. Selected examples include inducing of ferro or ferrimagnetic exchange in 1D chains, inducing chirality via inorganic linkers, and realization of the mix-valent compounds. Synthetic explorations resulted in the development of novel method of Se activation allowing to produce a diverse set of inorganic chalcogenides. The developed activated Se precursor allows us to produce Ag_2Se-based materials via benchtop room temperature chemistry. The developed synthetic method opens ways for precise doping of Ag_2Se allowing to regulate transport properties. We demonstrated Ag_2Se-based materials with remarkable thermoelectric performance with a maximum zT of 1.3 and averaged zT of 1.15 in 25-120°C range which outperforms all reported Ag_2Se materials and is on par with the best n-type Bi_2Te_3 and Mg_3Bi_2 materials. The latter materials require high-temperatures and complex synthetic modifications, while our synthesis employs a simple and sustainable benchtop chemistry to yield efficient room temperature thermoelectrics. Synthesis of magnetic $PtSe_2$-based materials will be also discussed.

About the speaker: Kirill Kovnir works on synthetic solid state chemistry of emergent energy materials including the development of innovative synthetic routes towards metastable compounds. Kirill grew up in Ukraine. After completing graduate studies and a couple of postdoctoral stints in Germany and US, Kirill started his independent career in 2011 at UC Davis where he received tenure. Soon after that, in 2017, Kirill relocated his group to Iowa State University. Kirill's research interests are in the broad field of solid-state and materials chemistry. Understanding the synthesis-structure-property relationship is a key to the rational design of such materials.