JOINT SEMINAR

PHYSICS & CHEMISTRY

Thursday, September 29 | 3:15-4:15 p.m. | RNS 150

ST · OLAF COLLEGE

Easy as One-Two-Five?: Ternary I-II-V Semiconductors as Non-Toxic Earth Abundant Energy Materials

The world's population is quickly increasing and, with it, our energy demand. By 2050, it is predicted that we will need twice the energy we used in 2011. To make matters worse, we rely on fossil fuels to satisfy 80% of our energy needs. Aside from the lack of sustainability with a non-renewable energy source, the combustion of these fuels leads to the emission of a plethora of undesirable compounds. These compounds include greenhouse gases, such as carbon dioxide, which lead to intense climate change, air pollutants, such as nitric acid, which lead to smog and acid rain, and heavy metals such as mercury and uranium. Fortunately, recent advances in material design are making many renewable energy solutions commercially viable. However, these materials frequently rely on toxic elements such as lead.

My research focuses on the development of filled tetrahedral semiconductors comprised of elements from group I, II (or XII), and V. These materials (collectively known as Nowotny-Juza compounds) are suggested as anode materials in Li ion batteries as well as for photovoltaic and thermoelectric devices. By synthesizing these compounds from low temperature solution phase methods, their application is increased and, in the case of LiZnSb, we find that the samples crystallize in a different crystal structure than those seen previously. While interesting from a fundamental perspective, this new polytype has practical relevance due to its extremely high thermoelectric performance which could lead to it being the next state-of-the-art thermoelectric material.

Arthur White

Arthur White received his B.S. in chemistry from the University of Wisconsin – Madison in 2014. Working under the supervision of Prof. Danny Fredrickson, Arthur developed a passion for the structure and properties of periodic solids. Upon starting graduate school at Iowa State University, he became interested in energy related applications and found a way to merge these two areas through the first syntheses of I-II-V nanocrystals. While already promising materials, their extension to the nanoscale makes them more suitable for both photovoltaic and thermoelectric devices. By being joint advised in both theoretical (Prof. Gordie Miller) and synthetic (Prof. Javier Vela) chemistry, the development of novel energy materials can be expedited through rapid screening of promising compounds before synthetic work begins.