

Physics Colloquium

Intercalation: How to Spice Up a Two Dimensional Sandwich

Dr. Tim Kidd

Assistant Professor of Physics
Physics Department
University of Northern Iowa

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4:00 p.m.

114 Begeman Hall

Two dimensional systems contain some of the most interesting electronic and magnetic behaviors found in nature. We have been performing magnetic, structural, and synthesis experiments aimed at developing novel electronic and magnetic states within a class of two dimensional materials known as the layered dichalcogenides. These dichalcogenides are formed of planar layers of molecularly bound metals and chalcogens (chalcogen = S, Se, or Te). The layers are separated stacks by a relatively large gap characterized by weak van der Waals forces. We have performed a series of investigations into tuning the properties these systems by intercalation, which is a doping process in which atoms or molecules are induced to reside within the gaps between the layers. Intercalation is an especially form of doping, in that it is reversible, the overall structure of the materials is largely unchanged, and one is able to introduce a far higher concentration of dopants than is usually possible. Our efforts have led to several new discoveries in this area. We have used intercalation to drastically alter surface chemistry, induce new magnetic states into a non-magnetic material, and explore how non-magnetic and magnetic ions self-order. We have also developed a new method for altering the concentration of intercalated ions using a scanning electron microscope. Combining this method with exposure to reactive gasses can yield sub-micron crystal formation in controlled areas of the sample in a novel mix of user controlled and self-assembled processes. Finally, our attempts to control two dimensional crystal growth have fortuitously yielded some quasi- one dimensional systems that are up to millimeters in length, but with diameters ranging in the micron scale (trichalcogenide whiskers) down to tens of nanometers (dichalcogenide nanotubes). This colloquium will present an overview of our current efforts and how the research will progress in the coming years, including the continued involvement of undergraduate, graduate, and high school teachers as research assistants.

Everyone Welcome! Refreshments Provided.