Condensed Matter Physics Seminar Series

Novel Electronic Phenomena in Few-Layer 1T' TMDs

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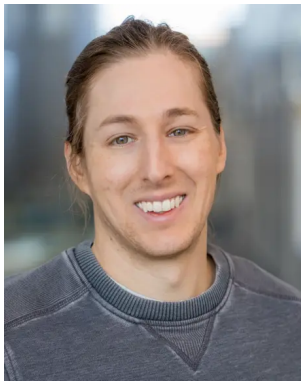

Electrostatic control over correlated states like superconductivity and topological states and understanding how these states compete is a longstanding effort of the condensed matter community. Part of understanding these interactions is solving materials challenges posed by considerable amounts of disorder, both extrinsic and intrinsic in the 2D limit. In this talk, I will focus on a family of transition metal dichalcogenides (TMDs) where we have put significant effort towards solving these issues in hopes of observing phenomena not available in the traditionally stacked 2H semiconductors. Specifically, our group has developed robust techniques for synthesizing and measuring a particularly interesting family of layered transition metal dichalcogenides: 1T′-TMDs. These materials are known for their exotic superconducting, topological, and ferroelectric properties. While many calculations of the electronic properties have been put forward for the bulk and monolayer structures of 1T′-TMDs, much remains unknown about the multilayer properties. Presumably, one expects elemental substitutions of this family of materials to all be similar in behavior. However, as noted from prior reports the properties can differ considerably. For example, monolayer 1T′-WTe2 is a quantum spin Hall insulator, while monolayer MoTe2 is a superconductor. Adding to this, when substituting elements on the transition metal site, different stacking orders of the monolayer 1T′ structure can be realized. Owing to these complexities, I will discuss the changes to electronic properties that we measure in bulk and few-layer heterostructures via magnetotransport when moving between the different stacking orders (1T′→Td→2M). If time allows, I will also discuss the emergence of interesting superconducting phenomena in bilayers of these materials when high pressure is applied.

Since 2020, Rhodes has been an assistant professor at the University of Wisconsin-Madison in the Materials Science and Engineering Department. Rhodes originally earned his bachelor's degree in mathematics and physics at Clemson University, and his PhD in physics at Florida State University, where he primarily worked at the National High Magnetic Field Laboratory synthesizing topological and superconducting bulk single crystals and measuring their Fermiology. From 2016 to 2019, Rhodes was a CNI postdoctoral research scientist at Columbia University, primarily working in the field of 2D materials. Since joining UW-Madison, Rhodes has continued to work both in synthesizing novel bulk materials and expanding the library of 2D materials and physical properties that can be realized therein.

Friday, October 10th at 10am
4-330 PAB