

Spring 2018 Joint Colloquium

Materials Department & Materials Research Laboratory

Professor Harley Johnson

Department of Mechanical Science and
Engineering
Faculty Fellow, Office of the Vice
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University of Illinois at Urbana-Champaign



Friday, June 1st, 2018

11:00 am, ESB 1001

A Dislocation Framework for Moiré Engineering in 2D Materials

Moiré patterns are commonly observed in layered systems of 2D materials such as graphene, h-BN, MoS₂, etc, or when 2D materials are grown on crystalline metal substrates. To understand moiré patterns, we introduce the concept of interlayer or van der Waals (vdW) dislocations, and show that arrays of these defects constitute the moiré patterns associated with regions of commensurability and incommensurability between the layers. We note that moiré patterns and the defects appearing therein are electronic structure objects formed by weak interactions between the layers, locked into place by strong in-plane interactions in the constituent layers, and can thus be understood as topological states. We explain several experimentally observed moiré phenomena, including the distinct moiré patterns formed by various combinations of 2D materials on the same metal support layers, as well as point and line defects in moiré patterns. Our vdW dislocation framework makes it possible to design topological states in moiré patterns through an understanding of defects in the underlying 2D layers. The framework recasts and extends the emerging field of vdW heterostructures.

Bio

Harley T. Johnson is a Professor in the Department of Mechanical Science and Engineering and a Faculty Fellow in the Office of the Vice Chancellor for Research at the University of Illinois at Urbana-Champaign. He has research interests in the mechanics and physics of electronic and optical materials. He holds graduate degrees from Brown University, and an undergraduate degree from Georgia Tech. He is a fellow of ASME, a past recipient of an NSF CAREER Award, and he has received the ASME Thomas J. R. Hughes Young Investigator Award for Special Achievement in Applied Mechanics. In 2014-2015 he was a Fulbright U.S. Scholar in France and an Invited Professor at Université Joseph Fourier in Grenoble.

<https://mechanical.illinois.edu/directory/faculty/htj>

Hosted by Matt Begley.