Condensed Matter & Biophysics Seminar

THURSDAY

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4:00 P.M.

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Custom low-dimensional material systems explored from atom to bulk

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The ability to controllably layer atomically thin crystals into custom-made materials holds promise for realizing physical systems with distinct properties, previously inaccessible. The experimental results described in this talk seek to uncover the unique nature of the charge carriers in such few-atoms-thick materials as well as effects that interlayer coupling and disorder have on their properties.

In the first part of the talk I will discuss scanning tunneling microscopy (STM) and spectroscopy (STS) experiments performed on graphene systems at low temperatures and in magnetic field. We find that twisting graphene layers away from the equilibrium Bernal stacking leads to the formation of Moiré patterns and results in a system with novel electronic properties tuned by the twist angle. Moreover, we study Landau quantization in graphene and by performing spatially resolved STM/STS we demonstrate the true discrete quantum mechanical electronic spectrum within the Landau level band near an impurity in graphene in the quantum Hall regime.

In the second part of the talk I will focus on the 1T polymorph of TaS_2, which has one of the richest phase diagrams among the layered transition metal dichalcogenides. We address the question of how the transition from bulk to few layers affects the different phases in this material. Specifically, we use variable temperature Raman spectroscopy measurements and show that the existence of the most highly ordered phases depend on having a critical number of stacked 1T-TaS_2 layers. Furthermore, using low temperature STM/STS, we explore the spatial variation of the electronic properties of the commensurate charge density wave phase at the atomic level.

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