Correlating atomic-scale defects with device-scale transport in graphene and black phosphorus

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Abstract

Black phosphorus is a particularly exciting member of the 2D material family because of its direct and tunable bandgap from 0.4-1.5 eV and high mobility carriers [1]. However, samples degrade rapidly in air and exhibit unintentional p-doping [2]. In this talk, I will first present our recent scanning tunneling microscopy experiments that connect the p-doping and degradation to the prevalence of atomic vacancies in black phosphorus from commercial sources [3]. In addition to being chemically active sites, these vacancies have an electronic signature that extends over 20 lattice constants, and we observe charging and discharging of defect states through tip-induced band bending (see Figure 1). I will also present our latest experiments exploring the relationship between defects and transport in device geometries for black phosphorus and graphene. These experiments exploit a unique opportunity in 2D crystals to correlate changes in atomic-scale structure with device-scale transport, and can address fundamental questions about the role of disorder in 2D crystals.

References

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Figures

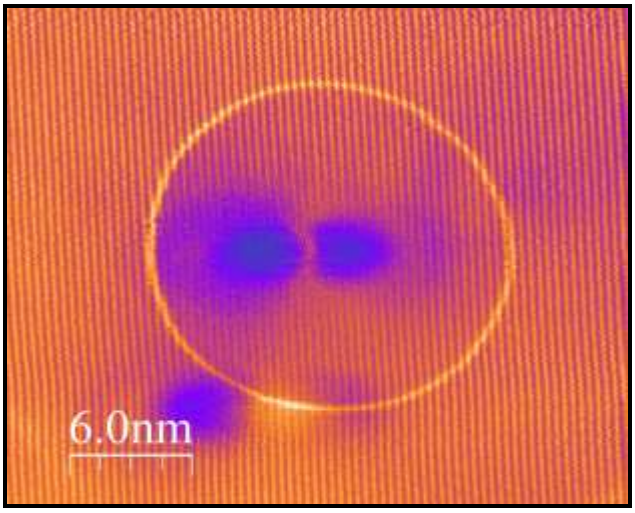

Figure 1: Scanning tunnelling spectroscopy of black phosphorus at -300 mV showing the electronic signature of single defects, including a bright ring characteristic of charging the defect state.