Transport Studies in Black Phosphorus Field Effect Transistors

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Ultrathin black phosphorus (BP), or phosphorene is the second known elementary two-dimensional material that can be exfoliated from a bulk van der Waals crystal. Unlike graphene it is a semiconductor with a sizeable band gap that allows both high carrier mobility and large on/off ratios. Its excellent electronic properties make it attractive for applications in transistor, logic, and optoelectronic devices. However, it is also the first widely investigated two dimensional electronic material to undergo degradation upon exposure to ambient air. Therefore a passivation method is required to study the intrinsic material properties, understand how oxidation affects the physical transport properties and to enable future application of phosphorene. I will show that atomically thin graphene and hexagonal boron nitride crystals can be used for passivation of ultrathin black phosphorus. I will also discuss experiments where we characterize few-layer black phosphorus field effect transistors on hexagonal boron nitride (BN) and compare with results obtained with BP fully encapsulated with BN.