"Spintronics with 2D Materials"

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2:00 PM

The anticipated death of Moore’s law, which describes the exponential growth of processor capabilities, has resulted in a frantic search for new materials and new types of devices that can replace or (more likely) complement silicon MOSFETs as the primary components in device technologies. New spintronic (spin-based) devices fabricated from 2D van der Waals materials and their heterostructures promise lower-power, higher-performance devices and an avenue beyond Moore’s law. 2D van der Waals materials, such as graphene and transition metal dichalcogenides, can be isolated in monolayer form, either through large-area growth or mechanical exfoliation from bulk, can be placed cleanly on any substrate, and can be stacked to form heterostructures with a variety of made-to-order properties. The quintessential 2D material, graphene, has been identified as an ideal spin channel due to its high mobility and low hyperfine interaction, which can theoretically lead to extremely long spin lifetimes. However, control of the spin relaxation in graphene-based structures is necessary to achieve the envisioned utility of graphene in future spintronic devices beyond Moore’s law. Such control has been elusive. In this talk we will discuss overcoming the three major limiting factors in obtaining high performance spintronic devices with 2D materials: the spin channel, the substrate, and the tunnel barrier. We will discuss spintronics measurements in graphene using functionalized graphene as the tunnel barrier to overcome the conductivity mismatch problem and issues with the more commonly used oxide tunnel barriers. We will also discuss spin dynamics experiments and proximity induced spin orbit coupling in non-local spin valves that incorporate the transition metal dichalcogenide WSe2 as the substrate material. The work will be put in context with the search for memories and computing devices that use alternative state variables, and we will detail our plans for future work.

Host: Nikolic