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Spintronics with carbon-based materials

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Recent years witnessed increasing research activity in exploiting carbon-based materials as a spin transporting channel, which introduces a new avenue for device integration and functionality. In this talk, I will present application of an organic-based magnetic/non-magnetic semiconductor as an electron spin polarizer/spin transporting layer in the standard spintronic device geometry. The application of organic small molecule films as the spin transporting layer has been studied extensively recently. However, conceptual understanding of how the spins are injected into and transport through these organic semiconductor films was still lacking. With careful study on film thickness, temperature, and bias dependencies, significant differences between tunneling and giant magnetoresistance were resolved. In addition, the room temperature organic-based magnet, $V(TCNE)_x$ was successfully incorporated into the standard magnetic tunnel junction devices in tandem with LSMO ($La_{2/3}Sr_{1/3}MnO_3$) film.

The second part of this talk will be devoted for engineering spin dependent dispersion in graphene and non-local transport study therein. Graphene has been perceived to be an outstanding material for delivering spin information due to its high electron mobility and weak spin-orbit coupling. The mandatory requirement for exploiting electron spins in graphene is facile control of spin-orbit coupling. Instilling spin-orbit coupling into graphene allows splitting and detecting electron spins via spin Hall and its inverse effect. We introduced ultrathin metal pad on graphene to enhance spin-orbit coupling and studied non-local signal to demonstrate alternative spin current generation.