Spin Filtering in Two-Dimensional Magnetic Tunnel Junctions

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The recently discovered two-dimensional van der Waals magnets have attracted a lot of attention from the research community. In my presentation, I will briefly survey the field, and discuss the unique properties they display and the applications they drive using a prototypical magnetic semiconductor, Chromium triiodide (CrI$_3$). The first-principles methods based on density functional theory are reliable methods for exploring spin-dependent transport in tunnel junctions. In a particular density functional theory study of a tunnel junction involving face-centered cubic Cu (111) electrodes and a CrI$_3$ tunnel barrier, we find about 100% spin polarization of the tunneling current and tunneling magnetoresistance of about 3,000% associated with a change of magnetic ordering in CrI$_3$, consistent with experimental observations. We interpret these results in terms of the spin and wave-vector dependent evanescent states in CrI$_3$ which control the tunneling conductance. Our results elucidate the mechanisms of spin filtering in CrI$_3$ tunnel junctions and provide important insights for the design of magnetoresistive devices based on 2D magnetic crystals.

March 3, 2021
4:00 pm
Zoom Meeting
Everyone Welcome!