Ising spintronics in transition-metal dichalcognides

Abstract

The hybridization between the d orbitals of transition-metal dichalcognides, MX_2 (M = Mo, W; X = S, Se, Te) and magnetic adatoms is governed by the symmetry of adsorption sites, leading to orbital dependent spin-flip scatterings. Furthermore, doping and circularly polarized optical pumping allow control over the orbital and spin degree of freedom of carriers in MX2. Combining these features, we propose a mechanism to electrically erase the spin moment and optically determine its orientation of a transition-metal adatom with d^9 configuration on a MX_2 monolayer. Based on an effective model Hamiltonian, we calculate the spin lifetime and the polarization of magnetic adatoms, revealing their connections to doping levels and polarization of carriers in TMDCs straightforwardly. Moreover, the system exhibits a sizable magnetic anisotropy, suggesting a mechanism called Ising spintronics. Our *ab initio* calculations suggest that this Ising-type spintronics is realizable in Co, Rh, or Ir adatoms on MoS_2.