Ferromagnetic Semiconductors: Preparation and Properties

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The injection of spins into nonmagnetic semiconductors has recently attracted great interest due to the potential to create new classes of spin-dependent electronic devices. A recent strategy to achieve control over the spin degree of freedom is based on dilute ferromagnetic semiconductors. Ferromagnetism has been reported in various semiconductor groups including II-VI, III-V, IV, and II-IV-V₂, which will be reviewed. On the other hand, to date the low solubility of magnetic ions in non-magnetic semiconductor hosts and/or low Curie temperature have limited the opportunities. Therefore the search for other promising ferromagnetic semiconducting materials, with high magnetic moments and high Curie temperatures (Tₐ), is of the utmost importance.

In this talk, we also introduce new pure ferromagnetic semiconductors, MnGeP₂ and MnGeAs₂, exhibiting ferromagnetism and a magnetic moment per Mn at 5K larger than 2.40 μB. The calculated electronic structures using the FLAPW method show an indirect energy gap of 0.24 and 0.06 eV, respectively. We have observed spin injection in MnGeP₂ and MnGeAs₂ magnetic tunnel junctions through semiconducting barriers.