

Electrical characterization of a 2D ferromagnetic material

The representative 2D materials, graphene, h-BN, and MoS₂, have interesting mechanical, electrical and optical properties and have exhibited fascinating physical phenomena so far. However, they mostly lack one important physical property in physics, magnetism. The new 2D materials such as CrSiTe₃, CrI₃, and FePS₃, which began to be studied recently, possess ferro- or antiferro-magnetic properties even in atomic level thickness and are expected to reveal deep level of physics in 2-dimensional confinement.

In this talk, our recent works on thickness dependence of magnetic properties of a ternary 2D material, Fe₃GeTe₂, which shows the ferromagnetic behavior, will be presented. Fe₃GeTe₂ was studied with hall measurement and STM methods. From the hall measurement, it exhibited the anomalous hall effect due to its intrinsic ferromagnetism. Interestingly, the magnetic properties such as coercivity changed significantly with decreasing thickness changing from weak ferromagnet to strong ferromagnet. Also, we found some mixed magnetic behavior of ferromagnetism and anti-ferromagnetism, which seems to be due to partial oxidation. STM study revealed some magnetic domains on the surface. The domain structures barely changed below Curie temperature, but disappeared above the critical temperature, which suggests they are magnetic structures. Since this material is conducting and very thin, and has high Curie temperature of around 220K, it appears to have a high potential for practical applications at micro- and nano-scales.