On-line SPICE-SPIN+X Seminars

Wednesday, 17th November 2021, 15:00 (CET)

The seminar will be via Zoom (Meeting ID: 878 3076 4009) and live streamed in the SPICE YouTube Channel.

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Magnetism and spin dynamics control by carrier doping in van der Waals magnet Cr2Ge2Te6

Two-dimensional (2D) van der Waals (vdW) materials have been intensively and extensively studied in the last two decades. A magnetic version of vdW systems has only gained attention since 2017 where a few mono-layers of exfoliated magnetic vdW ones were reported to sustain magnetism [1.2]. Since then, scientists started to seriously explore the physics and materials science of this new class of materials by applying their own research ideas and growth/measurement techniques. These material groups are ideal, for example, in studying magnetism and spin transport at the truly 2D limit, and in exploring how these materials can be responded by external stimuli such as current-induced torques and electric field. These experiments will also be enriched by an unlimited combination of their heterostructures that can be fabricated without significant lattice-matching constraints present in typical thin-film sample-growth techniques such as MBE and sputtering. Furthermore, inherent low symmetry nature of vdW materials will offer a wealth of spin-orbit Hamiltonians that are the backbone of current-induced magnetization switching research and future technologies [3].

We started to work on one of magnetic 2D vdW materials, Cr2Ge2Te6 (CGT), to study its spin dynamics and how to control the magnetism by any external stimuli. In this presentation, I will start with a brief introduction of magnetic 2D vdW materials and then move on to our latest work of controlling magnetism (Curie temperatures and magnetic anisotropies) in CGT by electric field [4] and chemical doping. Both doping techniques show the change of carrier density in CGT by orders of magnitude (from insulator to metallic). As a result, the exchange coupling strength has been greatly enhanced, leading to Curie temperature enhancement. The carrier doping also modifies the spin-orbit interaction within CGT which is measured by a significant change of the magnetic anisotropy parameters. These have been characterized by magneto-transport as well as spin dynamics techniques [5]. Furthermore, if time permits, I will also briefly show our photon-magnon coupling in CGT and on-chip resonator systems.

[1] Gong et al. Nature 546 265 (2017).
[2] Huang et al., Nature 546, 270 (2017).
[3] H. Kurebayashi et al., arXiv:2107.03763; Nat. Rev. Phys. (in-press).
[4] Verzhbitskiy et al., Nature Electron. 3, 460 (2020).
[5] For example, for undoped CGT, Khan et al., Phys. Rev. B 100, 134437 (2019); arXiv:1903.00584.