Chez Pierre

Presents ...

Monday, December 12, 2016
12:00pm Noon
MIT Room 4-331

Chez Pierre Seminar

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"2D crystal heterostructures and growth by molecular beam epitaxy"

Layered materials or 2D crystals are made of sheets of atoms covalently bonded within each layer but via van der Waals (vdW) force between layers, therefore, also called vdW materials. As a result, lack of broken bond on the surface of a layered crystalline material is the fundamental departure from the conventional inorganic materials. Graphene, hBN, black phosphorus, metal dichalcogenides (TMDs), Bi_2Se_3, $NbSe_2$ are some prime examples of 2D crystals. *How are layered materials unique in properties? What unique technologies and applications can layered materials offer?* These are central questions the research community of layered materials has strived to answer in the past 12 years or so.

In the past my group proposed and demonstrated some interesting applications taking advantage of the gate-tunable optical transparency of graphene [1]. The current research has been largely focused on interlayer tunneling in 2D heterojunctions and growth of these 2D heterostructures using molecular beam epitaxy (MBE). Tunneling enables a genre of transistors called tunnel field effect transistors (TFETs), which have been touted as the most promising candidate for post-CMOS electronic switches. Thin-TFET stands for Two-dimensional Heterojunction INterlayer Tunneling FET, a name my group coined for the ultimately scaled TFET [2]. To realize Thin-TFETs, we need to control doping, gating efficiency, band offset etc. In this talk, I will share our progress and the challenges we have faced to date on both devices and materials growth. In our effort to understand and control MBE growth of layered $SnSe_2$, rock-salt SnSe is found to grow on Bi_2Se_3; ARPES confirms it is a topological crystalline insulator.

[1] Berardi Sensale-Rodriguez et al, Nat. Comm. (2012) doi:10.1038/ncomms1787; Rusen Yan et al. Appl. Phys. Lett. (2012) DOI: 10.1063/1.4734955

[2] Mingda (Oscar) Li, et al. IEEE J-EDS (2015). DOI:10.1109/JEDS.2015.2390643; Rusen Yan et al. Nano Letters, (2015). DOI: 10.1021/acs.nanolett.5b01792; Suresh Vishwanath et al. J. of Material Research, (2016). DOI: 10.1557/jmr.2015.374