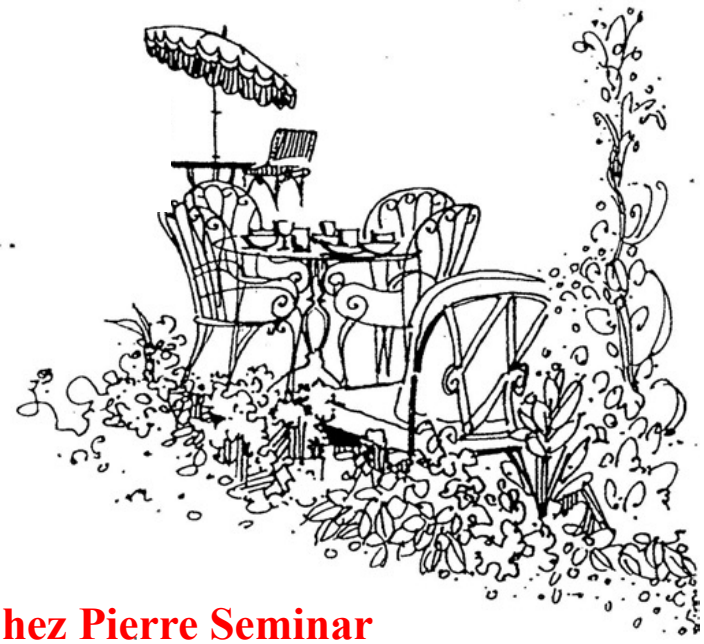
Chez Pierre

Presents ...

Friday, September 30, 2022
2:00 pm
Duboc Room - 4-331



Physics + DMSE special Chez Pierre Seminar

Barbaros Oezyilmaz, National University of Singapore

"Synthesis and properties of monolayer amorphous carbon and cobalt doped black phosphorus".

In the first part of my talk I will discuss the synthesis, by laser-assisted chemical vapour deposition, of centimetre-scale, free-standing, continuous and stable monolayer amorphous carbon, topologically distinct from disordered graphene. Bulk amorphous materials have been studied extensively and are widely used, yet their atomic arrangement remains an open issue. Unlike in bulk materials, the structure of monolayer amorphous carbon can be determined by atomic-resolution imaging. Extensive characterization by Raman, X-ray spectroscopy and transmission electron microscopy reveals the complete absence of long-range periodicity and a threefold-coordinated structure with a wide distribution of bond lengths, bond angles, and five-, six-, seven- and eight-member rings. Direct measurements confirm that such a material is insulating, with resistivity values similar to those of boron nitride grown by chemical vapour deposition. Free-standing monolayer amorphous carbon is surprisingly stable and deforms to a high breaking strength, without crack propagation from the point of fracture. Such excellent physical properties could prove useful for permeation and diffusion barriers in applications such as magnetic recording devices and as copper diffusion barrier.

In the second part of my talk I will discuss ferromagnetism in Co-doped semiconducting black phosphorous (BP) up to room temperature. Ferromagnetic semiconductors combine electric field tunability with nonvolatility. Yet, despite decades pursuing such co-functionality, room-temperature ferromagnetic order remains a challenge. In Co-doped gate tunable BP, carrier-mediated room-temperature ferromagnetism is corroborated by its performance as a robust ferromagnetic contact in semiconducting tunnelling spin-valves and by a large anisotropic magnetoresistance. We demonstrate electric field selection of the dominant majority/minority spins, allowing both gate-controllable inversion and sup-pression of tunnelling magnetoresistance on demand.

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