

Seminar Speaker:

Dr. Lian Li

Department of Physics and Astronomy

West Virginia University



Date and Location

5/9/2019

634 Science and Research Bldg. 1

2:30PM – 3:30PM

Enhanced Functionalities in Quantum-Mater Heterostructures

It is often said that “the interface is the de

vice”. Nowhere is this more evident than 2D quantum materials, whose properties can only be meaningfully discussed when their interfaces with the substrates are clearly defined. The band gap of graphene provides an apt example. It is on the order of μeV while freestanding, but can reach tens of meV when placed on 3D topological insulator Bi_2Se_3 . Perhaps the most remarkable example of substrate modulation in a 2D quantum material is the recent discovery of an order-of-magnitude increase in superconducting transition temperature (T_C) when a single layer of FeSe is grown on SrTiO_3 substrate. In this talk, I will highlight our recent work on UV light induced persistent superconductivity [1] and the determination of sign-changing d -wave pairing symmetry by quasiparticle scattering [2] in single layer FeSe/ SrTiO_3 . I will also briefly summarize our earlier work on other quantum materials such as topological insulators, including strain tuning the Dirac states [3] and electrical detection of spin-momentum locking [4], as well as zigzag graphene nanoribbons where electron-electron interaction opens a gap up to 1.6 eV [5]. Our findings reveal unique features of the van der Waals epitaxy of these quantum matters [6], and opportunities for tailoring their physical and electronic properties at the atomic scale through heterostructuring.

[1] “Light induced non-volatile switching of superconductivity in single layer FeSe on SrTiO_3 substrate”, *Nat. Commun.* **10**, 85 (2019).

[2] “Evidence for d -wave superconductivity in single layer FeSe/ SrTiO_3 probed by quasiparticle scattering off step edges”, *Nano Lett.* **19**, 2497 (2019).

[3] “Tuning Dirac states by strain in the topological insulator Bi_2Se_3 ”, *Nat. Phys.* **10**, 294 (2014).

[4] “Electrical detection of charge-current-induced spin polarization due to spin-momentum locking in Bi_2Se_3 ”, *Nat. Nanotechnol.* **9**, 218 (2014).

[5] “Direct experimental determination of onset of electron-electron interactions in gap opening of zigzag graphene nanoribbons”, *Nat. Commun.* **5**, 4311 (2014).

[6] “Spiral growth without dislocations: Molecular beam epitaxy of the topological insulator Bi_2Se_3 on epitaxial graphene/ $\text{SiC}(0001)$ ”, *Phys. Rev. Lett.* **108**, 115501 (2012).

Bio: Prof. Lian Li received his BSc and MSc in Physics from Yunnan and Tongji University in China in 1983 and 1987, and PhD in Physics from Arizona State University in 1995. He received a JSPS Fellowship to conduct research at the Institute for Materials Research, Tohoku University, Japan from 1995 to 1996, and held a staff research associate position at UCLA from 1996 to 1999. He joined the Physics department at the University of Wisconsin-Milwaukee as an Assistant Professor in 1999, and was promoted to full Professor in 2007. He joined the Department of Physics and Astronomy at West Virginia University as the Robert L. Carroll Professor of Physics in 2016. Prof. Li received the E. W. Müller Outstanding Young Scientist Award from the International Field Emission Society (1996) and NSF CAREER Award (2001).