Atomic and electronic reconstruction at van der Waals interface in twisted 2D Materials

Philip Kim

Department of Physics, Harvard University, Cambridge MA 02138, USA

Control of the interlayer twist in the vdW interface has been widely used to engineer an artificial 2-dimensional (2D) electronic systems by the formation of a moiré superlattice. Many exotic physical phenomena occur associated with the incommensurability of the moiré superstructures; the fractal energy spectrum of Hofstadter butterfly and recently discovered Mott insulating and unconventional superconducting behavior of the 'magic' twist angle bilayer graphene have demonstrated the wealth of the nontrivial topology of electronic band structures. However, the atomic scale microstructures and electronic structures of vdW interfaces have been understood in the frame of rigid rotational moiré structures without atomic scale relaxation. In this presentation, we will discuss the engineered atomic scale reconstruction at twisted vdW interface [1]. We find that the vdW interaction energy that favors interlayer commensurability competes against the intralayer elastic lattice distortion to form a quasi-periodic domain structure, inducing profound changes in electronic structure. Particularly, we show quantitative analysis of the engineered atomic-scale reconstruction completely controlled by the twist angle between two graphene layers and anomalous electron transport occurring in the network of topologically protected propagation modes along the domain boundaries. Interfaces between vdW materials are a crucial material platform for realization of novel quantum electronics. Our discoveries of atomic scale reconstruction at vdW interfaces will provide a new route to engineer the 2D materials for exceptional functionalities.

References

[1] H. Yoo et al. arXiv:1804.03806.