Electron dynamics in topological surface and twisted bilayer graphene

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Electron dynamics in the surface states of a three-dimensional topological insulator (3D-TI) and in a quasi-crystal twisted bilayer graphene (QCBLG) on the SiC substrate will be reported on the basis of the results by TrARPES. By combining TrARPES with the probing photon energy of 6 eV and the measurements of quasiparticle interference using scanning tunneling microscopy, we elucidated suppression of the elastic scattering is in the helically-spin-polarized surface electrons in an unoccupied upper Dirac cone of 3D-TI $Bi_{1.5}Sb_{0.5}Te_{1.7}Se_{1.3}$. [1] The observed inelastic decay time of the electrons in TSS is longer than 10 psec just above E_F. During the TrARPES measurements, the system exhibits a bulk insulator to metal transition, and the decay time decreases through the transition. In twisted bilayer graphene, each layer has Dirac cones which are largely modified by the interlayer interaction depending on the twisted angle. In the case of QCBLG with the 30 degree twisting angle, we can have new opportunities for studying electronic properties due to quasiperiodic symmetries. [2] Using TrARPES with the probing photon energy of 21. 7 eV, we have revealed transient unbalanced electron distributions in the two graphene layers.

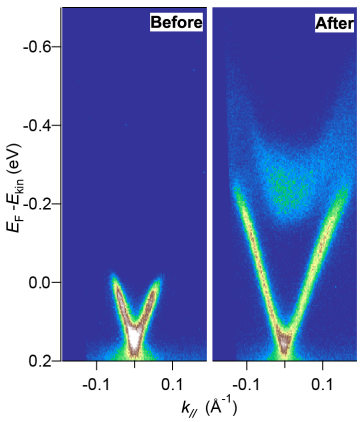

Fig. 1: TrARPES intensity maps before and after a pump pulse. [1]

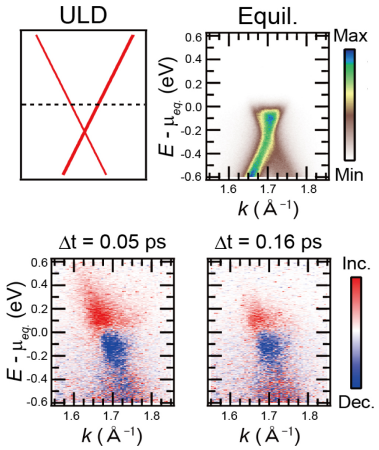

Fig. 2: Upper graphene band and equilibrium ARPES and TrARPES intensity maps.

References:

[1] S. Kim, *et al*, Phys. Rev. Lett. **112**, 136802 (2014).
[2] S. J. Ahn, *et al*., Science **361**, 782 (2018).