An Alternative to "Twistronics" – Topological Moiré by Inert Monolayers

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Abstract

Observation of superconductivity, magnetism, correlated insulating and quantized anomalous Hall phases in magic-angle twisted graphene bilayer has opened the new field of "twistronics" in condensed matter physics [1-5]. Thus far, the "twistronics" has been exclusively applied to topologically trivial systems, such as graphene and transition metal chalcogenides. An even more dramatic enrichment of observable phenomena should be realized if moiré patterning could be induced on surfaces of three dimensional (3D) topological insulators, but the experimental realization of topological moiré superlattices remains elusive. Here, we demonstrate that the topological moiré can be created by adsorbing an inert insulating layer on a surface of topological insulator and show that the moiré superlattice potential at the interface replicates the topological surface state and affects it in a way fundamentally different from the trivial moiré. Our observations provide an intriguing scenario of correlated topological phases induced by moiré superlattice, that may result in topological superconductivity, high-Chern number phases and exotic non-collinear magnetic textures.

References

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Figures

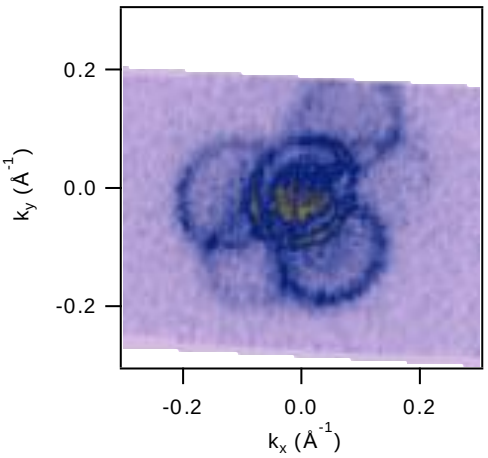

Figure 1: Fermi surface of a layer of an inert material adsorbed on Bi_2Se_3 with a lattice constant roughly 5% larger than that of Bi_2Se_3. The moiré superlattice potential replicates the Dirac cone of the Bi_2Se_3 topological surface state. Due to the spin-momentum locking, the resulting electronic structure is fundamentally different from moiré superlattices in twisted layers of topologically trivial materials such as graphene.