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Giant Band Gap Quantum Spin Hall Phase with Weak Spin-Orbit Coupling[1] ZHIGANG WU, MARC DVORAK, Colorado Sch of Mines — The typical quantum spin hall (QSH) insulator relies on spin-orbit (SO) coupling to open a band gap in the bulk material. However, the intrinsic SO coupling is often rather weak, especially in graphene, and most researchers have focused on enhancing the SO interaction, e.g., by adsorbing heavy adatoms, to increase the bulk band gap. We have demonstrated that if patterned properly, periodic defects on graphene are able to induce intervalley scattering between Dirac points and then open a large (~ 1 eV) bulk band gap. Using both tight-binding method and density functional theory, we explore the possibility of creating a QSH insulator in a graphene nanomesh. We find that an arbitrarily weak SO coupling is able to induce the spin-filtered edge states to traverse the bulk band gap. Here the SO coupling is not responsible for band gap opening, but only serves to connect the K and K' points, leading to a QSH phase with a giant band gap without the existence of strong SO coupling.

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