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Engineering and probing topological properties of Dirac semimetal films by asymmetric charge transfer[1] JOHN VILLANOVA, EDWIN BARNES, KYUNGWHA PARK, Virginia Tech — Dirac semimetals (DSMs) have topologically robust three-dimensional Dirac nodes (degenerate Weyl nodes) and Fermi-arc states connecting the node projections at a surface. Recently, Na_3Bi and Cd_3As_2 have been experimentally confirmed to be DSMs, where the Dirac nodes are stabilized by crystal symmetries. In heterostructures involving DSMs, charge transfer occurs at the interfaces, which can be used to probe and control their bulk and surface topological properties through surface-bulk connectivity. Here we demonstrate that despite a band gap in DSM films, asymmetric charge transfer at the surface enables one to accurately identify locations of the Dirac-node projections from gapless band crossings and to examine and engineer properties of the topological Fermi-arc surface states connecting the projections, by simulating adatom-adsorbed DSM films using a first-principles method and by comparing with the effective model. We show that the amount of charge transfer changes the unique spin textures near the projections and the separation between the Fermi-arc states. Our results can be observed by top or bottom surface gating without adatoms.

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