Electronic Stucture of Topological Insulators

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The recently discovered three-dimensional topological insulators (TIs) belong to a class of insulators in which the bulk gap is inverted due to the strong spin-orbit interaction [1,2]. A direct consequence of such bulk band structure arises at the surface: the spin-polarized topologically protected massless metallic states, forming a Dirac cone [3-6]. These surface states (SS) exhibit many interesting properties resulting from the fact that the spin of electron is locked perpendicular to its momentum, thus forming a SS spin structure that protects electrons from backscattering. This makes topological insulators potentially promising materials for creation of new quantum devices.

Here recent theoretical and experimental results on electronic structure obtained for new families of TIs are presented. Comparison of topological surface states with classical [7] and Rashba splits [8-11] surface states as well as Dirac cone state in graphene [12] is given. The origin of buried topological surface states is discussed [4,6]. Materials science problems and perspectives in the field of TIs are discussed.

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