Antiferromagnetic order induced by doping rare-earth metals in topological insulators

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There are many interests to achieve long-range magnetic order in topological insulators of Bi_2Se_3 or Bi_2Te_3 by doping magnetic transition metals such as Fe and Mn. The transition metals act as not only magnetic dopants but also electric dopants because they are usually divalent. However, if the doping elements are rare-earth metals such as Ce and Gd, which are trivalent, only magnetic moments can be introduced. We fabricated single crystals of Ce- and Gd- doped Bi_2Se_3 and Bi_2Te_3 with various doping contents [1-3]. We observed magnetic phase change from paramagnetic (PM) to antiferromagnetic (AFM) phase by doping. This PM to AFM phase transition agreed with the density functional theory calculations showing a weak and short-ranged AFM coupling via the intervening Te ions. At a critical point corresponding to the magnetic phase transition, exotic two-dimensional properties arising from topological surface state electrons were observed such as non-metallic behavior, large linear magnetoresistance, and quantum oscillations.

References

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