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Magnetism in Non-magnetic Materials

By

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Abstract

Ferromagnetism in non-magnetic materials has attracted much attention. Many studies have been carried out to identify the origin of the unexpected ferromagnetism, and to explore potential applications of such materials. Following successful prediction of room temperature ferromagnetism in III-V and II-VI semiconductors doped with 2p light elements, we extended the same strategy to topological insulators. We demonstrate simultaneous magnetic and hole doping achieved with a single dopant, carbon, in Bi_2Se_3 by first-principles calculations. Carbon substitution for Se (CSe) results in an opening of a sizable surface Dirac gap (up to 82 meV), while the Fermi level remains inside the bulk gap and close to the Dirac point at moderate doping concentrations. Using a combined theoretical and experimental approach, we reveal the origin of the long-range ferromagnetic coupling in a series of MOFs, constructed from antiferromagnetic dimeric-Cu(II) building blocks. Room temperature ferromagnetism was also observed in Teflon tape (polytetrafluoroethylene) when it is mechanical stretched, cut or heated. Our first-principles calculations revealed that the room temperature ferromagnetism originates from carbon dangling bonds and strong ferromagnetic coupling between them. More

recently, we found that phosphorene can be made magnetic by an interplay of phosphorous vacancy and strain. The origins of magnetism in various types of non-magnetic materials will be discussed.

Biography

Feng Yuan Ping received his B.Sc. in Physics from Lanzhou University in 1982 and Ph.D in Physics from Illinois Institute of Technology in 1987, respectively. He joined the Department of Physics at the National University of Singapore as a faculty member in 1990, following a 3 year postdoctoral stint at Purdue University. His research interest is in computational condensed matter & materials physics, focusing mainly on the understanding of fundamental properties of materials for advanced technologies, and prediction of new materials based on ab initio electronic structure calculations. He has studied various materials including dilute magnetic semiconductors, graphene spintronics, high-k materials, topological insulators, semiconductor and metal surfaces and interfaces, materials for magnetic data storage, etc. He has authored/co-authored more than 400 scientific papers in international refereed journals and one book. Professor Feng is a fellow of the American Physical Society, a fellow of Institute of Physics, Singapore, and an Academician of the Asian Pacific Academy of Materials. He served as the Head of Physics Department as NUS from 2007 to 2014. He is currently the Vice President of Materials Research Society of Singapore, and the Secretary of International Union of Materials Research Societies.

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