Itinerant Ferromagnetism in a Metal-Organic Framework

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Magnetic materials that combine magnetic ordering with other desirable physical properties may find use in a broad range of applications. Efforts to design multifunctional magnetic materials prompted an active search beyond traditional solid-state compounds to coordination solids. In particular, metal-organic frameworks offer intrinsic porosity from their crystal structures and facile tunability of chemical and electronic structures that lack in traditional magnetic materials. However, magnetic ordering in metal-organic frameworks is typically limited to low temperatures, and a limited number of guidelines exist for improving the ordering temperature. We show itinerant ferromagnetism that engenders magnetic ordering in a mixed-valence chromium triazolate material. This compound exhibits the highest ferromagnetic ordering temperature, T_c, of 225 K among coordination solids. In addition, the double-exchange mechanism results in a variable-temperature conductivity data that feature barrierless charge transport behavior below T_c and a large negative magnetoresistance of 23 % at 5 K, suggesting potential applications of double-exchange coordination solids in magnetoelectrics and spintronics. Our understandings on itinerant ferromagnetism in the mixed-valence chromium triazolate material can provide a general strategy towards designing and synthesizing other porous solids with attractive magnetic and charge transport properties suitable for various applications.