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Magnetic quasicrystals: Current Status and Open Questions

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The magnetic properties of quasicrystals have been the subject of intense theoretical and experimental interest since Dan Shechtman's discovery of icosahedral quasicrystals in 1982 [1]. The first generation of Al-TM (TM = 3d transition metal) quasicrystals with moment bearing elements, such as Al-Mn and Al-Pd-Mn, provided some insight into the fate of magnetism in quasiperiodic systems: only a small fraction of the Mn ions carry a moment and these moments appear to be distributed randomly on the quasilattice. The discovery of the Zn-Mg-R and Cd-Mg-R (R = rare earth) quasicrystals with sizeable local moments that interact via indirect exchange (i.e. the RKKY interaction) reinvigorated the search for long-range magnetic order in the icosahedral phase. However, to date, all of the known quasicrystals with moment bearing elements exhibit frustration and spin-glass-like behavior at low temperature. The recent discovery of binary magnetic quasicrystals in the R-Cd system [2] is particularly exciting because their closely related crystalline approximants, RCd6, exhibit long-range antiferromagnetic order at low temperature [3] permitting a detailed investigation of the effects of aperiodicity on magnetic interactions in this system. Here, I will describe the status of investigations of the R-Cd quasicrystals and RCd6 approximants with regard to their structural and magnetic properties. This research was supported by the Office of the Basic Energy Sciences, Materials Sciences Division, US Department of Energy (DOE).

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