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Organic-based Magnets - New Materials for New Physics[1]

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Organic-based materials exhibiting the technologically important property of bulk magnetism, including ferro-, ferri-, and metamagnetism, have been prepared. These magnets are prepared via conventional organic chemistry methodologies, but unlike classical inorganic-based magnets do not require metallurgical processing, and are frequently soluble in conventional solvents (e.g., toluene, dichloromethane, acetonitrile, THF). They have saturation magnetizations that in some cases exceed twice that of iron metal on a mole basis as well as have coercive fields exceeding that of Co5Sm. Also magnets with critical temperatures exceeding room temperature have been prepared. In addition to an overview of the observed magnetic behaviors, numerous examples of magnets made from molecules will be discussed. These will include [M(III)(C5Me5)2][A], [Mn(III)(porphyrin)][A] (A = cyanocarbon etc. electron acceptors) as well as M[TCNE]x (M = V, Mn, Fe, Co, Ni) which for M = V is a room temperature magnet, which can be fabricated as a thin film magnet. Another new class of magnets of [Ru(II/III)2(O2CR)4]3[M(III)(CN)6] (M = Cr, Fe; R = Me, t-Bu) composition will also be discussed. This broad new family of materials have examples that exhibit most of known magnetic phenomena observed for classical inorganic transition/rare earth metal based magnets, as well as some new, unexpected phenomena and combinations of properties not previously reported. The design of examples of these organic-based magnets will be discussed setting the stage for an overview of their unusual magnetic properties and new physics that will be discussed by Arthur J. Epstein.

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