RCMS ·G-COE Seminar

"Molecule-based Magnets:

New Materials, Chemistry, and Physics for this Millennium"

Lecturer : Prof. Joel S. Miller (University of Utah)

Date : Mon. 27 June 15:00 – 17:00

Place : Chemistry Gallery (Noyori Bldg. 2F)

Abstract: Molecule-based materials exhibiting the technologically important property of bulk magnetism have been prepared and studied in collaboration with many research groups worldwide frequently exhibit supramolecular extended 3-D structures. These magnets are prepared via conventional organic synthetic chemistry methodologies, but unlike classical inorganic-based magnets do not require high-temperature metallurgical processing. Furthermore, these magnets are frequently soluble in conventional solvents (*e. g.*, toluene, dichloromethane, acetonitrile, THF) and have saturation magnetizations more than twice that of iron metal on a mole basis, as well as in some cases coercive fields exceeding that of all commercial magnets (*e.g.*, Co_5Sm). Also several magnets with critical temperatures (T_c) exceeding room temperature have been prepared. In addition to an overview of magnetic behavior, numerous examples of structurally characterized magnets made from molecules will be presented. Our groups has discovered 7 families of molecule-based magnets, mostly organic-based, and have significantly contributed to an eight family based upon the Prussian blue structure. Four examples magnetically order above room temperature and as high at 127 °C. These will include $[M^{III}(C_5Me_5)_2][A]$, $[Mn^{III}(porphyrin)][A]$ (A = cyanocarbon etc. electron acceptors) as well as $M[TCNE]_x$, which for M = V is a room temperature magnet that can be fabricated as a thin film magnet via Chemical Vapor Deposition (CVD) techniques. A newer class of magnets of $[Ru_2(O_2CR)_4]_3[M(CN)_6]$ (M = Cr, Fe; R = Me, *t*-Bu) composition will also discussed. For R = Me an interpenetrating, cubic (3-D) lattice forms and the magnet exhibits anomalous hysteresis, saturation magnetization, out-of-phase, $\chi''(T)$, AC susceptibility, and zero field cooled-field cooled temperature-dependent magnetization data. This is in contrast to R = *t*-Bu, which forms a layered (2-D) lattice. Additionally, new magnets possessing the nominal Prussian blue composition, $M'[M(CN)_6]_x$ and $(Cation)_yM'[M(CN)_6]$, but not their structure will be described.

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