Research-Proposal Seminar

Single-Molecule Magnets and Single-ion Magnets for High Density Data Storage

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Single-molecule magnets (SMMs)/single-ion magnets (SIMs) are a class of coordination/ organometallic complexes which show slow relaxation of magnetization in absence of applied magnetic field.[1] This class of compounds is of paramount importance due to its potential applications in data storage and data processing. They have potential to store approximately 10,000 times data per unit volume than the traditional storage devices. However, there is a technological barrier in terms of utility at room temperature. Till now, Chemists have been able to synthesize SMMs/SIMs which show slow relaxation of magnetism little above liquid nitrogen temperature.[2] To enable technological viability, chemists are trying to synthesize SMMs/SIMs which show slow magnetic relaxation at room temperature and have high energy barrier for spin/ magnetism reorientation. The most common strategy employed to prepare SMMs/SIMs with high blocking temperature (T_b) and high energy barrier (U_{eff}) is to increase uniaxial anisotropy by suitably choosing metal ion and ligand system. Both, transition metal and lanthanoid ions have been used for synthesis of SMMs, however, observation reveal that lanthanoid ions are better candidates for SMMs synthesis. Till now, it has been established that lanthanide ions which have oblate type electron density distribution can be coordinated with ligands with axial electron density such as cyclopentadienyl anion (Cp^-) based substituted variants. Basically, lanthanoid ions such as Dy^{3+}, Ce^{3+}, Ho^{3+}, Nd^{3+}, Tb^{3+}, Pr^{3+} have pronounced oblate character in terms of electron density distribution, means that most of the electron density is in equatorial xy-plane rather than in axial z-plane. Thus, when we use a ligand that coordinates to lanthanoid ion from axial direction, it minimizes electronic repulsion. However, in case of lanthanoid ions with prolate electron density such as Sm^{3+}, Pm^{3+}, Er^{3+} etc., We should use ligands which coordinate onto equatorial direction, thus minimizing electronic repulsion. As a result, the probability of getting SMM/SIMs with higher energy barrier and blocking temperature increases. They can be used in the development of building blocks for molecule-based storage devices, quantum computing, and spintronics.[3]

Considering technological scope of this field, I will be proposing my research topic "The synthesis of SMMs/ SIMs with higher blocking temperature and high energy barrier".

References

[1] Mondal *et al.* Angew.chem.Int. Ed., **2012**, 51, 7550-7554.
[2] Guo *et al.* Science **2018**, 362, 14000-1403.
[3] Luo *et al. Dalton Trans.*, **2011**, 40, 12651-12655.

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Venue : seminar hall (CB310)