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ΘΕΜΑ: Engineering Spin Crossover Molecules by Assembly into
Nanomaterials

ΗΜΕΡΟΜΗΝΙΑ: Παρασκευή, 5 Μάϊου 2023

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ΤΟΠΟΣ: *Αμφιθέατρο Συνεδριακού ITE/IECHM*

ΠΕΡΙΛΗΨΗ

Much effort has been expended in recent years to develop the materials assembly of spin crossover (SCO) complexes and impressive results have been achieved in stabilizing and isolating monodisperse nanoparticles,¹ nanocrystals,² thin films,³ micro- and nanopatterned media,⁴ Langmuir-Blodgett surface mono- and multilayers⁵ and hysteretic soft media assemblies.⁶ The dimensional reduction of SCO complexes has been observed to have an effect on the magnetic behaviour of the materials.⁷ This is a result of the electronic bistability being related to the collective behaviour of the SCO centres in the crystalline lattice. We have shown that the SCO properties were retained for Fe(III) SCO complexes.⁸ Here, we now probe magnetic, electrostatic and conductive properties of rare SCO Mn(III) complexes at the nanoscale. The successful preparation of a series of nanoassemblies was achieved with Mn(III) SCO complexes including nanoparticles, nanowires, nanofibers and nanocrystals and piezoelectric and conductive properties along and across the wire were probed using conductive AFM.



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Σύντομο βιογραφικό

Grace Morgan heads a team of synthetic coordination chemists at University College Dublin, Ireland. Over the past decade the team has built up a library of switchable metal complexes and studied their properties in the solid state. The switching function arises from the ability of the complexes to pair and unpair their electron spins with changing temperature and the effect has been mostly studied in Mn^{3+} and Fe^{3+} complexes. As this results in two distinct electronic and vibrational states, effectively two molecules are stored in one and each has a unique spectral fingerprint. Non-contact switching is also possible by irradiation or application of an external magnetic field. As this library has grown we have come to understand the importance and prevalence of phase changes in the solid state which accompany molecular switching and their capacity for thermal storage. We have also shown how the compounds can be modified so as to assemble them into robust and regular 1D nanowires using template methods. More recently we have expanded the range of media beyond solid state crystalline materials. The metal complexes are ionic and in the primary design the switchable complex is positively charged with a polyatomic charge balancing anion. We have recently modified the design of both cation and anion so as to lower the melting point and produce room temperature ionic liquids which show room temperature magnetic switching. We have also designed metallic liquid crystals with reliable hysteretic spin state switching, and amphiphilic complexes which assemble into organized micelles in organic solvents with hysteretic switching in solution. We now recognise the potential of our compounds to operate as temperature-dependent paramagnetic contrast agents in solution in magnetic resonant imaging (MRI) applications where the temperature gradient may help distinguish healthy and diseased tissue.

Academic Appointments

May 2016- Associate Professor, School of Chemistry University College Dublin.

Sep 2013-May 2016 Senior Lecturer, School of Chemistry and Chemical Biology, University College Dublin.

Sep 2001-Sep 2013 College Lecturer, Department of Chemistry, University College Dublin.

Jan 2000-Sep 2001 Assistant Lecturer, Department of Chemistry, University College Dublin.



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Education and Professional Training

1999-2000 Postdoctoral researcher, Max Planck Institut für Strahlenchemie, Mülheim an der Ruhr, Germany.

1996-1999 Instructor in Inorganic Chemistry, Queen's University, Belfast.

1995-1996 Postgraduate Certificate in Education, Queen's University, Belfast.

1991-1995 PhD in Coordination Chemistry, The Open University (with Prof Jane Nelson, Belfast).

1994 Chartered Chemist status (CChem) awarded by the Royal Society of Chemistry

1988-1991 BSc (Hons) Chemistry, Queen's University, Belfast.

Recent talks:

- Invited Speaker, 14th International Symposium on Crystalline Organic Metals, Superconductors and Magnets (ISCOM2022), Le Pouliguen, France, September 25-30, 2022.
- Keynote Speaker, 16th European Biological Inorganic Chemistry Conference (EuroBIC), Grenoble, France, July 17-21, 2022.
- Invited Speaker, Ninth North American-Greece-Cyprus Workshop on Paramagnetic Materials, 2022 (Ayia Napa, Cyprus, May 9-13, 2022)
- Invited Speaker, Pacificchem, December 16 - 21, 2021 (Virtual)
- Invited Speaker, Bordeaux-Bayreuth 2B Switch Symposium 30 August – 31 September 2021 (Virtual).

Recent publications:

- Spontaneous Chiral Resolution of a MnIII Spin Crossover Complex with Room Temperature Hysteresis, Conor T. Kelly, Ross Jordan, Solveig Felton, Helge Müller-Bunz, Grace G. Morgan, 2023 CEJ in press.
- Proton-Induced Magneto-Modulation in FeIII, C. T. Kelly, S. Dunne, I. A. Kühne, A. Barker, K. Esien, S. Felton, H. Müller-Bunz, Y. Ortin, G. G. Morgan, 2023, Angew. Chem. Int. Ed., 2023, accepted.
- Compressed and Expanded Lattices - Barriers to Spin State Switching in Mn3+ complexes, Michelle M. Harris, Irina A. Kühne, Conor T. Kelly, Vibe B. Jakobsen, Ross Jordan, Luke O'Brien, Helge Müller-Bunz, Solveig Felton, Grace G. Morgan, Cryst. Growth, Des., 2023, in revision.
- Crystallographic Detection of the Spin State in FeIII Complexes, Conor T. Kelly, Michael Griffin, Kane Esien, Solveig Felton, Helge Müller-Bunz, Grace G. Morgan, Cryst. Growth Des., 2022, 22, 6429-6439. doi.org/10.1021/acs.cgd.2c00468