

Dynamic Magnetic Properties of Lanthanide Organometallic Sandwich Complexes

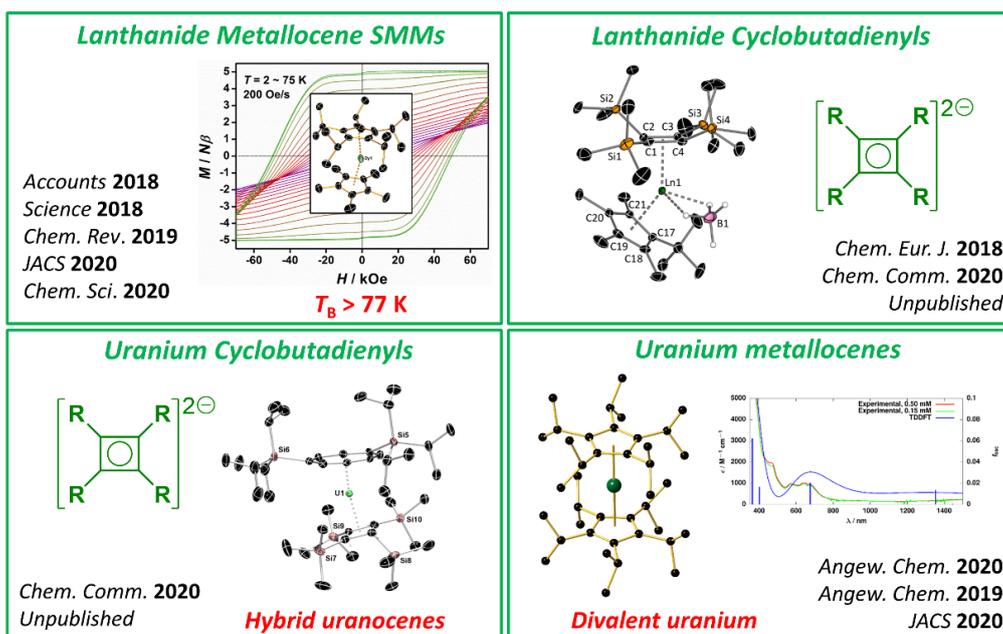
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Organometallic sandwich compounds play a leading role in the development of f-element chemistry. In addition to making significant contributions to our fundamental understanding of structure, bonding and reactivity in lanthanide and actinide compounds, organometallic sandwiches are used in catalysis and a variety of small-molecule activation processes. The reactivity of f-element sandwich compounds often has no parallel with transition metals or main group elements and offers many opportunities for development.

In contrast, the magnetic properties of f-element organometallics have not been studied extensively, which is surprising given the many applications of lanthanides in magnetic materials and related areas, such as MRI. This is particularly true in the case of single-molecule magnets (SMMs), a family of compounds that show magnet-like behaviour below a characteristic blocking temperature.

Since 2010, we have developed a large family of dysprosium SMMs based on the metallocene structural unit. We have applied our findings to develop a working model that allows the magnetic blocking temperature to be increased in a rational way. The culmination of our work is a dysprosium metallocene SMM with a blocking temperature of 80 K, which is (currently) the only example to function above liquid nitrogen temperatures.



Using our structure-property relationship, we are now focused on improving the SMM properties further. To do this, our attention has shifted toward a ligand that is well-known in transition metal chemistry but is extremely rare in the f-block: the strained ring species cyclobutadienyl (see image, above right). In this seminar I will present our recent findings in this area, showing how the beastly [η⁴-C₄(SiMe₃)₄]²⁻ ligand can be tamed with appropriate control of the chemical conditions.

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