PhD 2022-2025
Ecole Doctorale de Chimie de l'Université de Lyon

LATE-STAGE FUNCTIONALIZATION OF MULTIFUNCTIONAL SINGLE-MOLECULE MAGNETS
FONCTIONNALISATION TARDIVE DE MOLECULES-AIMANTS MULTIFONCTIONNELLES

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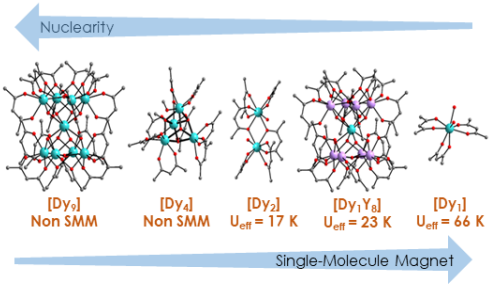
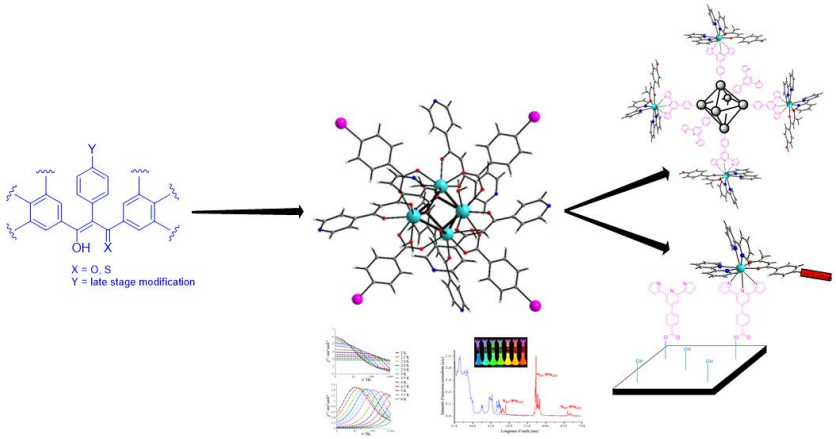
Key words: organic & coordination chemistries, lanthanide ions, magnetism, luminescence

Context: Single-Molecule Magnets (SMM) are at the forefront of new technological advances in quantum information processing and spintronics. In effect, as their magnetic properties originate at the molecular level, it has been anticipated that their magnetic capacity storage could be larger (1 000-10 000 times) than those of traditional bulk magnets. Since several years, with the researches conduct by our two precedent PhD students, our team is working on the elaboration of multifunctional single-molecule magnets based on 4*f* elements, associating luminescence and magnetic properties. Our aim is to understand the correlation between molecular crystal structure and physical properties in order to develop more performant molecular objects (Figure above).



PhD project (Figure below): the 1st step (*organic chemistry*) will focused on the synthesis and characterization of the organic synthons (β-diketone and analogs), the first stone of the final molecular building block. As these ligands are important in terms of properties, they have to be especially designed for the coordination of lanthanide ions and the control of the final complex nuclearity. As well, these ligands would have to be thoughtful in order to anticipate organic late stage functionalization (optical antenna, radical entities …), directly on the final molecular object and in order to develop the auto-organizations of these complexes on surface or on a metallic cluster. The 2nd step (*coordination chemistry*) of these researches will aim at the conception and characterization of original multifunctional 4*f*-based SMM, controlling the complex nuclearity in the view of the desired properties. Finally (*material chemistry*) these new multifunctional SMM will be inserted in materials either by deposition on surface or bridged to metallic clusters (Mo or Re ones) in order to obtain nanometric objects at the interface of nanoparticules and molecular complexes, combining both specificities as well as properties.



This *multidisciplinary project* will allow the applicant to develop strong skills in organic chemistry reactions as well as in coordination chemistry ones, spectroscopic characterizations (NMR, luminescence, UV-Vis), solid-state characterizations (IR, single-crystal and powder x-ray diffraction (team equipment), magnetism (team equipment)). International collaborations

Team publications on the subject: (a) *Angew. Chem .Int. Ed.*, **2022**, 61, e202113114; (b) *Inorg. Chem. Front.*, **2021**, 8, 914-926; (c) *Chem. Commun.*, **2021**, 57, 53-56; (d) *Chem. Eur. J.*, **2020**, 26, 4389-4395; (e) *Angew. Chem. Int. Ed.*, **2018**, 57, 17089-17093; (f) *Inorg. Chem.*, **2010**, 49, 10970-10976; (g) *J. of Am. Chem. Soc.*, **2008**, 130, 12445-12455; (h) *Angew. Chem. Int. Ed.*, **2006**, 45, 4659-4662; (i) *Inorg. Chem.*, **2007**, 46, 6108-6119

Requested: the candidate will have to be rigorous, motivated and particularly interested by interdisciplinary researches. Organic chemistry syntheses background is requested and coordination chemistry one would be appreciated.