

Ph-D in Inorganic Chemistry**Transition metal complexes organized into magnetic nano-structures**

**Groupe des  
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Inorganiques**

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One of the major challenges in material chemistry is the synthesis of so-called multifunctional objects, *i.e.* which combine different properties, either in a composite way (without interaction between these properties) or in synergy. Among the multiproperty materials much studied at present, one can cite quote the ones whose magnetic properties can be modified under irradiation.<sup>[1-3]</sup> One may also cite the "opposite" case where the optical properties (luminescence) can be modified by the magnetic ordering.<sup>[4]</sup> Such materials lead to fascinating perspectives, either from a fundamental point of view or, at long term, for possible applications in the field of magneto-optical information storage.

Lamellar compounds (lamellar transition metal oxalates, phosphonates or oxides, MPS<sub>3</sub> compounds, double-layer hydroxides...) due to their flexibility are appropriate candidates to obtain such hybrid materials by association (insertion of grafting) of organic and inorganic subnetworks which combine their properties (magnetic or optical properties for instance).

Among these compounds, the Groupe des Matériaux Inorganiques of the Institut de Physique et de Chimie des Matériaux de Strasbourg (UMR 7504) is particularly interested in lamellar transition metal hydroxides of general formula M<sup>II</sup><sub>2</sub>(OH)<sub>3</sub>(X)·mH<sub>2</sub>O (with M = Co, Cu, Ni and X an easily substitutable anion, NO<sub>3</sub><sup>-</sup> or CH<sub>3</sub>COO<sup>-</sup>). These magnetic materials are particularly well adapted to the grafting of various organic molecules (carboxylates or dicarboxylates<sup>[5]</sup>).

This Ph-D work will consist in functionalizing these lamellar hydroxides by transition metal complexes and in studying the resulting structural, magnetic and optical properties of the hybrid compounds obtained.

We will focus on three types of complexes to graft:

\*complexes possessing a high magnetic anisotropy (Ni<sup>II</sup>, Mn<sup>III</sup>...) to modulate the anisotropy of the host matrix (modification of T<sub>C</sub> or T<sub>N</sub>, of the coercive field, etc...).

\*luminescent transition metal complexes such as [Ru<sup>II</sup>(bpy)<sub>3</sub>]<sup>2+</sup> and its derivatives (for which the luminescence properties are well documented<sup>[6]</sup>).

\*photo-active complexes, for instance light-induced spin-transition complexes such as [Fe<sup>II</sup>(phen)<sub>2</sub>(NCS)<sub>2</sub>].

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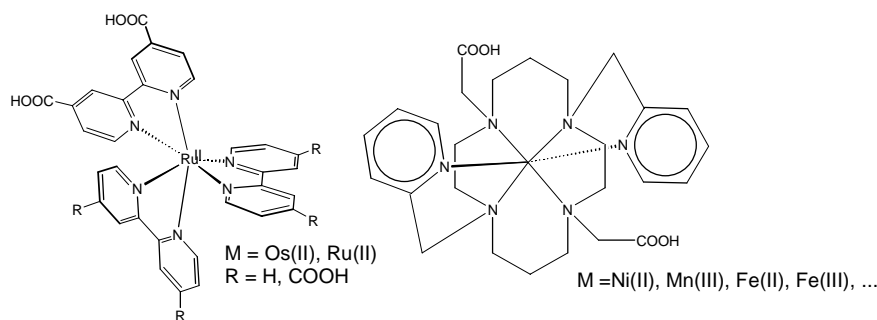


Fig. 1: example of complexes to be grafted.

Moreover, these complexes, or derivatives bearing other coordinating groups (carboxylate, phosphonate, nitrile...) will also be used in one-pot direct synthesis (for instance in hydrothermal conditions) along with other transition metal complexes in order to obtain new hybrid multifunctional compounds with different architectures.<sup>[7, 8]</sup>

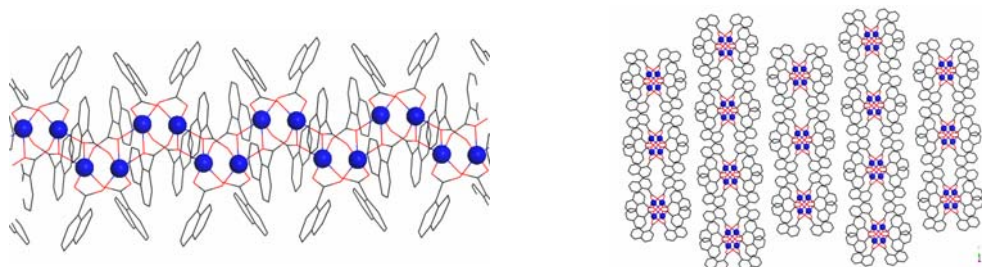


Fig. 2: example of a new 1-D structure obtained in the laboratory by hydrothermal synthesis<sup>[9]</sup>.

Finally, the synthesized molecules will also be used in relation with other research activities performed in the Groupe des Matériaux Inorganiques, for instance for functionalizing magnetic nanoparticles.

This Ph-D will necessitate an important work in synthesis (synthesis of the complexes, grafting into the lamellar hosts, and one-pot synthesis) along with characterizations, structural, magnetic and possibly photo-magnetic studies (IR and UV spectroscopy, X-ray diffraction, SQUID, EPR...)

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**Candidates** must have a good curriculum (in order to obtain the funding) and a good knowledge in molecular inorganic chemistry. Interested candidates are invited to send a CV, possibly along with a supporting letter (master supervisor for instance). (rogez@ipcms.u-strasbg.fr)

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