PhD position:
Confined synthetic approaches to layered multifunctional heterostructures and 2D magnets

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Since the discovery of the outstanding properties of graphene,[1] research on all kinds of nanosheets have increased considerably.[2] Yet although there has been efforts to induce magnetism in graphene and transition metal dichalcogenides, 2D materials with intrinsic magnetism had been missing until quite recently.[3] This discovery of monolayer magnetic materials is generating considerable excitement because it enables fundamental studies of magnetism in the true 2D limit and applications based on the integration of 2D magnetic layers into device structures.[4] Up to now, exciting results using atomically-thin Van der Waals materials have been obtained as proof of concept in the field of spintronics,[5] but other applications are already emerging, in nano-optics for instance,[6] and much more will come (sensing, data storage…). Nevertheless, despite these tremendous promises, it is striking that the number of explored materials remains rather small, and their nature essentially limited to Van der Waals materials (*e.g.* MPS_3, CrI_3, $Cr_2Ge_2Te_6$, Fe_3GeTe_2, VSe_2 or $MnSe_2$).

We have been interested for several years in the synthesis and characterization of lamellar hybrid materials, essentially for their magnetic, optical or electrochemical properties.[7,8] We have developed new synthetic strategies for functionalizing such layered materials.[9–12] Moreover, we are currently developing innovative methods to obtain easily and rapidly functionalized nanosheets resulting from the controlled exfoliation of layered precursors.[13] The proposed Ph-D project will consist in taking advantage of this experience to develop new approaches to 2D magnets and layered magnetic heterostructures. The present project is organized in two parts :

-the controlled growth in a 2D confined environment of *magnetic coordination networks* by connecting paramagnetic ions inserted in the interlamellar spacing of layered oxides, using the huge chemical toolbox offered by coordination chemistry (Figure 1).

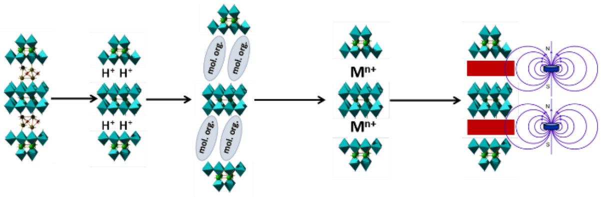

Figure 1. Schematic approach to the formation of 2D magnetic coordination networks in a confined layered environment. The first three steps have already been optimized in the group.

-the *selective exfoliation* of magnetic layered materials and their stabilization as nanosheets by embedding them in between layers of exfoliated oxides (Figure 2).

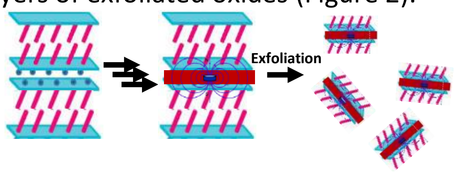

Figure 2. Schematic view of the formation of isolated magnetic 2D nanosheets

The advantages of these approaches will be will be i) the intrinsic protection of the magnetic 2D nanosheets, ii) the possibility to couple the magnetic properties of the 2D nanosheets with other properties brought by the oxide layers (luminescence, ferroelectricity, semi-conductivity…)

We are looking for a highly motivated graduate student, with experience in coordination chemistry and/or materials science. Knowledge in structural and spectroscopic characterizations will be highly appreciated. She/he must have a healthy ambition for her/his research, develop or optimize new synthetic procedures, as well as possess good English skills, with a view to write articles and present her/his work at international conferences.

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Application must be sent *via* the CNRS website using the following url : https://bit.ly/3vaHPdJ

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