ECOLE DOCTORALE DES SCIENCES CHIMIQUES - ED 040

Proposition de sujets de thèse pour la rentrée 2024 / 2025

Titre de la thèse	**Polyanionic framework for polar and magnetic materials design: in Search of Multifunctional Oxides**
Descriptif du sujet (10 lignes maximum)	Polar or magnetic oxides are of much interest in materials science and engineering. Combining the two properties within the same materials would obviously lead to enhance their potential technological applications. That is why, even if polar crystal design and synthesis is challenging, it is necessary for the material science community to develop new strategies to create these multifunctional materials enabling the control of magnetic order by electric fields and vice versa.. [1] Our polyanionic frameworks approaches allows to stabilize promising $RbMnPO_4$ [2] or langbeinite-type [3] powder samples exhibiting exciting magnetic properties. However, their expected bulk dielectric and elastic properties could not been characterized yet due to a lack of single crystal and/or optimized bulk pellets. First, powder growth phases by high temperature solution growth in molten phosphate salts are planned. Then, low temperature sintering approaches will be carried out to improve the densification. Finally, complementary state of the art microscopy, scattering and spectroscopic techniques such as high resolution electron microscopy (HREM), Electron energy loss spectroscopy (EELS), Electron Diffraction (ED) at CRISMAT (Caen), PDF (ICMCB), NMR and EPR (ICMCB) will be available in the Multiphos consortium and/or using large facilities (Synchrotron and Neutrons). Exotic magnetic properties such as chiral magnetism or hysteretic magneto capacitance effect due to the non centrosymetry nature of the nuclear cell are expected and/or have already been collected, However, even if the stabilisation of new solids with remarkable properties is an objective, it is the tuning of the physical properties that will be the ultimate challenge. That is why a special attention will be paid on the impact of external stimuli such as temperature, pressure, electrical and/or magnetic Field. Especially, ICMCB has just acquired a single device in France capable to collect magnetic properties under pressure. [1] A short history of multiferroics Physical Sciences Reviews https://doi.org/10.1515/psr-2020-0032 [2] Magnetic Properties of the $RbMnPO_4$ Zeolite-ABW-Type Material: A Frustrated Zigzag Spin Chain Inorg. Chem. 2013, 52, 16, 9627–9635 [3] Synthesis and characterization of a new iron phosphate $KSrFe_2(PO_4)_3$ with a langbeinite type structure Journal of Molecular Structure 2012,1030 145–148 and Langbeinite Phosphates $KPbM_2(PO_4)_3$ (M = Cr, Fe): Synthesis, Structure, Thermal Expansion, and Magnetic Properties Investigation Inorg. Chem. 2020, 59, 13245−13253.
Compétences souhaitées (nom du DEA, ou MASTER, etc…)	Formation en Chimie du solide ; Chimie des Matériaux ; Physique du Solide
Financement (connu ou espéré)	Bourse « Ministériel au mérite ». Programme ANR « Multiphos » en support
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