PhD at LRCS, Amiens, FRANCE
https://www.lrcs.u-picardie.fr/

Topic Title	***Synthesis and characterizations of anti-perovskite ionic conductors for all-solid-state batteries***
Principal Advisor	JANOT, Raphaël, raphaël.janot@u-picardie.fr, 03 22 82 79 01
Co-advisor	CHOTARD, Jean-Noël, jean-noel.chotard@u-picardie.fr, 03 22 82 53 31
Collaborations	CABELGUEN, Pierre-Etienne, UMICORE, Pierre-Etienne.Cabelguen@eu.umicore.com
Funding Source, Name of project	CIFRE
Date of publication of the offer	February 4th, 2020
Deadline for application	May 31st, 2020
Date of start of the Project	October 1st, 2020
Description of the Topic	Na-ion batteries are catching a lot of attention as a possible alternative to the Li-ion technology due to the unlimited sodium abundance. Despite impressive improvements of their performances in the last few years, safety issues due to the use of a flammable liquid electrolyte is still a major drawback. This is why Na-based All-Solid-State Batteries (Na-ASSB) could be a promising "next generation" of electrochemical energy storage devices. Recently, a new class of solid-state electrolytes has been proposed for Li-ASSB: the **Li-Rich Anti-Perovskites** related to the archetype Li_3OCl. Their intrinsic high ionic conductivity, stability against lithium metal coupled to a low temperature synthesis process make them materials of great interest. In this project, we propose the synthesis, structural and ionic conductivity characterizations of new **Li and Na Anti-Perovskite materials as solid electrolytes**. One of the great interests of Li or Na-antiperovskites is their chemical tunability. Anti-Perovskite phases of general formula $\mathbf{X_3^+B^{2-}A^-}$ can be easily modified by chemical substitution. Those chemical substitutions are expected to increase their ionic conductivity at room temperature.
Techniques to be used	Different synthesis routes will be explored during the PhD thesis such as solid state synthesis (followed by a subsequent quenching in some cases), mechano-chemistry, Spark Plasma Sintering (SPS). The materials will be characterized by X-Ray diffraction, Infrared and Raman spectroscopies, SEM and TEM, Thermal Analysis (DSC-TGA), ionic conductivity by Electrochemical Impedance Spectroscopy (EIS), electrochemical stability by Cyclic Voltammetry and Galvanostatic cycling, etc…
Skills of the Applicant	**Master 2** or engineering school (background in physics and chemistry, electrochemistry). A strong taste for electrochemistry, for physics and chemistry of interfaces and for materials is required for this PhD as well as a strong hands-in approach for experiments.
Contact (s)	raphael.janot@u-picardie.fr / jean-noel.chotard@u-picardie.fr
List of documents to provide	CV + motivation letter + list of references