NÉEL INSTITUTE Grenoble

Topic for Master 2 internship – Academic year 2022-2023

Emergent Properties of Novel High Pressure 1322-type Perovskite Oxides

General Scope: High pressure, high temperature (HPHT) synthesis methods can be used to stabilize metastable materials which cannot be prepared at ambient conditions. These conditions open up synthesis routes to a wide range of scientifically and technologically interesting complex transition metal oxides showing emergent properties such as high temperature superconductivity, piezoelectricity, ferroelectricity, magnetism, multiferroicity, and catalytic activity.

We are particularly interested in a family of materials known as 1322-type perovskites (FIG. 2). These materials have general formula $AA'_3B_2B'_2O_{12}$ and can accommodate transition metal cations at the A', B, and B' sites. In these materials, there a range of competing interactions result in a wide range of unusual magnetic behaviour. In this family, HPHT conditions are needed to stabilise transition metal cations in the square planar A' sites.

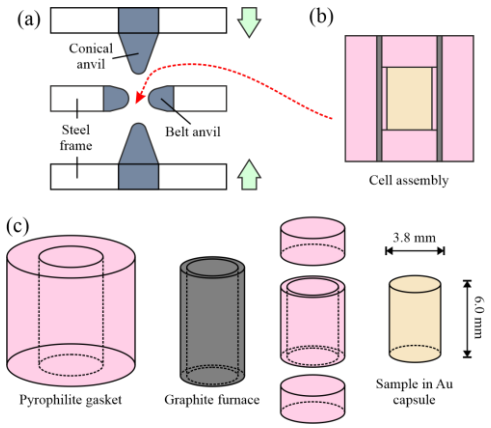

FIG 1. Schematic of a belt-type press (a) and cell assembly (b and c) for HPHT synthesis.

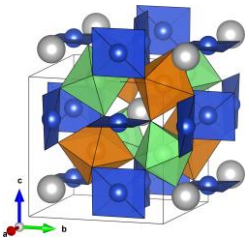

FIG 2. The 1322-type perovskite crystal structure.

Research topic and facilities available: The goal of this project is the synthesis of novel 1322-type perovskite oxides using the HPHT facilities at the Néel Institute, and to characterise their structural, physical, and magnetic properties. Structural characterisation will be carried out using the in-house X-ray diffractometers as well as nearby large-scale facilities (ESRF, ILL). A variety of physical, magnetic, and transport property measurement systems are available at the Néel Institute for sample characterisation.

Possible collaboration and networking: The intern will be working within the Materials, Radiation and Structure (MRS) team of the Néel Institute. They will collaborate closely with several researchers of the MRS team (experienced chemists, crystallographers and physicists) and work with the technical staff of the laboratory (for HPHT synthesis, physical characterisation, X-ray and neutron diffraction). There are possibilities for further collaboration with international researchers (UK, Japan, Taiwan).

Possible extension as a PhD: This master's internship could be extended into a PhD within the same research subject if a funding source for a PhD thesis is obtained (research project grant or PhD contract awarded by the Physics Graduate School of Grenoble).

Required skills: The candidate must have a background in condensed matter physics, materials science, or solid-state chemistry and interest in the synthesis and characterization of new materials.

Starting date: Any time

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