**Internship for USTB:**

**Potentiality of the layered oxides as thermoelectric materials**

***Context, description and skills acquired during this work***

Research attention is focussed on novel thermoelectric materials due to: (i) increasing in energy requirement and (ii) pollutions linked to human activities. Thermoelectric effect is the direct conversion between heat and electric energies. Several industries, ex. car makers, have investigated in the integrating of thermoelectric devices to recover the waste heat energy. However, the yield is still limited within available materials. A good thermoelectric material should present a high electric conductivity, a low thermal conductivity and a high thermopower (Seebeck) value. The best available materials content toxic or expensive elements and are not stable under air at mid- and high temperature range. To overcome those problems, researches of new materials (such as oxides, due to their chemical stable, friendly environment and possibility of working at medium and high temperature) are of great interest.

This 3 months stage will be held at the Orsay Institute of Molecular Chemistry and Materials, University Paris Sud, in France. The main objective of this work is to reduce the thermal conductivity, and therefore increase the performance of layered oxide materials. Layered materials, composed of alternative conducting and insulation layers, resemble to “natural quantum-well” systems, allowing to scatter the phonon contribution in thermal conductivity. One of difficulties is the sintering of those materials, in order to produce dense pellets for thermoelectric measurements. This could be resolved by applying of Spark Plasma Sintering (SPS) to nano-powders, prepared with sol-gel technique. The next step is to enhance the electrical conductivity of those materials, by studying different doping elements.

Several others techniques could be involved during this training, in particular, powder synthesis (sol-gel and/or precipitation), powder characterizations (XRD, SEM), SPS and physical measurements (Seebeck, electrical resistivity and thermal conductivity, specific heat…). Thermoelectric characterizations are carried out in our laboratory, where we dispose of several systems for measuring in equilibrium and out-of-equilibrium conditions (from few K till over 1000 K, and in various atmospheres such as vacuum, oxygen, argon or gas mixture…).

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