**Study of the SnO2 - ZnO nano-structured system as thermoelectric materials**

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

In the actual context of research and development of renewable energies, the thermoelectric is an alternative solution for fossils ones. Thermoelectric effect is the direct conversion between heat and electric energies. A good thermoelectric material should possess a high electric conductivity, a low thermal conductivity and a high thermopower (Seebeck) value. These three parameters are correlated. Several industries, ex. automotive makers, started to integrate thermoelectric systems to recover the waste heat energy. However, the yield is still limited; these systems require toxic or expensive inter-metallic materials. To enhance this yield, researches of new functional materials (such as oxides, due to their chemical stable, friendly environment adaptability and possibility to working at medium and high temperature) as well as the integration of nanostructure are of great scientific and technological interests.

This internship will be held at the “Institut de Chimie Moléculaire et des Matériaux d’Orsay”, University Paris Sud, in France. The main objective of this work is to reduce the thermal conductivity, and therefore the figure-of-merit (ZT) of nanostructured oxide materials by using a nano-inclusion system. As example, Bulk nanocomposites of ZnO-based oxides, with different contents of SnO2-based nano-inclusion could be prepared by spark plasma sintering. SnO2 nanoparticles (less than 5 nm) might scatter the phonon component and reduce the total thermal conductivity.

Several others techniques could be involved during this work, in particular, ball millings, powder characterizations (XRD, SEM-FEG, BET) and physical measurements (Seebeck effect, electrical resistivity and thermal conductivity, Hall effect, specific heat…). Thermoelectric characterizations will be carried out in our laboratory, where we dispose of several systems for measuring under 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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