Measurements and numerical simulations of modulated calorimetry on samples in levitation

The knowledge of the thermophysical properties of materials is essential for development and optimization of the industrial processes. Although different methods exist for the measurement of the materials' properties [1], not all of them are applicable for liquid metallic system because of high temperatures and of high chemical reactivity of the liquid metals. One of the solution is a levitation of the sample in an inert gas preventing any contact with the melted metals and their oxidation. Yet, measurements performed on a levitated sample require accurate data treatment since intense convective flows exist in the liquid sample. Alternatively, it is supposed that a static magnetic field can be used to damp the convection in the sample during the measurement [2].

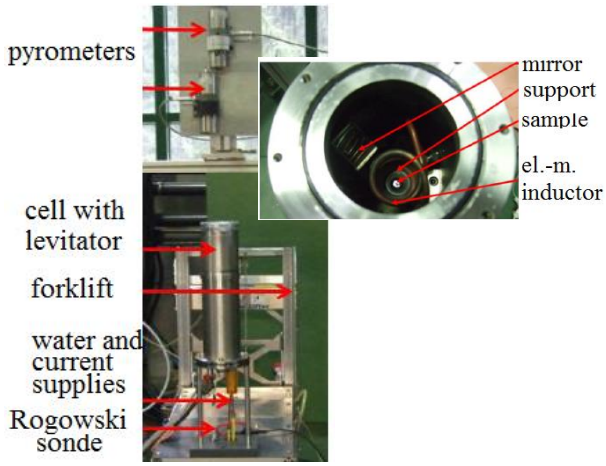

Fig.1 Setup for the measurement of the thermophysical properties on levitated samples

The group EPM of the SIMAP laboratory disposes a levitation system (Fig.1) with a geometry allowing its placement inside a strong (up to 5 T) static magnetic field generated by a Helmoltz Bobine. Also, a novel approach for the modulated calorimetry with a white noise has been proposed [3] and validated recently on the samples of a solid Nb and liquid Ni [4].

The aim of the proposed project is to improve our understanding of the heat and mass transfer processes during the measurements in the terrestrial setup using by EPM and in a setup at the ISS station in Material Science Laboratory [5]. Also, we would like to perform measurements for other materials, in particularly, for some metallic glasses.

The PostDoc candidate would be a person:

- with a strong experience in numerical modeling and good knowledge of ANSYS/Fluent (knowledge of script language and strong experience with UDF) and/or COMSOL (python language and interaction of COMSOL with Matlab)
- willing and able to devote up to 30% of her/his time to experiments. Preparation and realization of the latter will be assisted by technical staff but involvement of the candidate is compulsory

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References:

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3. P. Schetelat. PhD Thèsis «Modélisation et simulation de la calorimétrie modulée inductive » INPG, 2009 https://tel.archives-ouvertes.fr/tel-00521865 (in French)

4.A.Diarra, PhD Thèsis «Mesures de propriétés thermophysiques par procédé électromagnétique» UGA 2016 https://tel.archives-ouvertes.fr/tel-01382095/ (in French)

5. https://en.wikipedia.org/wiki/Materials_Science_Laboratory