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Equipe d'accueil (Nano)matériaux pour l'Energie (Energy)
http://ilm.univ-lyon1.fr/
Institut Lumière Matière
Campus LyonTech-La Doua
et le CEA-LETI (Grenoble)

Responsable de stage Valentina Giordano valentina.giordano@univ-lyon1.fr
Stephane Pailhes stephane.pailhes@univ-lyon1.fr

Intitulé du stage **Crystallization kinetics and transport properties in amorphous semiconductors**

Mots-clés thermal transport, electric transport, nanocrystallization, glasses, thermal conductivity, laser ultrasonics

Thermal management has become today one of the most urgent challenges that modern society has to face. Indeed, it represents the bottleneck for the development of many technologies such as nanoelectronics, data storage and energy harvesting, where one of the most urgent needs is to limit heat spread and dissipation while keeping good electric properties.

In this context, composites made of nanocrystalline inclusions embedded in an amorphous matrix have proved to be of interest, thanks to their extremely low thermal conductivity (κ_T), such as an amorphous, and electric or optic properties specific to the crystalline phase. As such, they are most promising for applications as phase change materials (PCM), now at the forefront of research for optical and electronic storage, where nanocomposites with low κ_T but a good electric contrast with the amorphous phase are foreseen[1], and thermoelectric materials (TE), for which the intertwining of the low κ_T amorphous phase with the high electric conductivity crystalline phase on the nanoscale has shown to be promising[2].

We propose here an experimental study of the preparation of semiconducting nanocomposites starting from the amorphous thin films prepared at the CEA-LETI, Grenoble.

Controlled thermal protocols allow to induce the nanocrystallization of the amorphous film, which is thermally promoted. Such crystallization involving a huge change in electronic properties, it can be monitored by following the electric resistivity during annealing, or via calorimetry measurements of the enthalpy involved in the crystallization process.

The trainee will participate to the setup of a calorimetry equipment recently acquired, which will allow for the measurement of the crystallization enthalpy, from which the crystallization kinetics can be deduced. These measurements will be complemented with resistivity measurements to connect the resistivity change with the crystalline fraction during crystallization. Such information will allow to understand the effect of a partial nanocrystallization on the electric transport in these materials.

References:
[1] T. Matsunaga et al., "Phase-Change Materials: Vibrational Softening upon Crystallization and Its Impact on Thermal Properties", Adv. Funct. Mater. 21, 2232–2239, (2011)
[2] M. Verdier, K. Termentzidis, and D. Lacroix "Crystalline-amorphous silicon nano-composites: Nano-pores and nano-inclusions impact on the thermal conductivity" J.Appl. Phys. 119, 175104 (2016)