Proposition de Stage M2 pour l'année 2018-2019

Equipe d'accueil (Nano)matériaux pour l'Energie (Energy) ; FemtoNanoOptics
http://ilm.univ-lyon1.fr/
Institut Lumière Matière

Responsable de stage Valentina Giordano valentina.giordano@univ-lyon1.fr
Paolo Maioli paolo.maioli@univ-lyon1.fr

Intitulé du stage **Thermal transport in nanostructured thin films: the challenge of a microscopic understanding**

Mots-clés thermal transport, nanocomposite, phonons, picoacoustics

One of the main challenges for our modern society consists in reducing the heat losses associated with energy consumption: indeed, about two thirds of produced energy is lost as heat, whatever the energy source and processing. Optimizing materials and processes for reducing heat dissipation, increasing thermal insulation, converting heat into other forms of energy is at the focus of an intense research effort. In this context, nanostructuration has arisen as a promising approach, as the presence of interfaces and the intertwining of different materials at the nanoscale has shown to effectively act on the quasi-particle responsible for heat transport – phonons – and not on other functional properties. As a result, thermal conductivity can be greatly reduced.

In this internship we propose to investigate nanostructured thin films, where an effective thermal conductivity reduction has been reported in the literature. Specifically, we will start this study on samples which are already under investigation in the Energy group for their possible thermoelectric applications, such as nanocomposites made of crystalline GeTe surrounded by amorphous carbon, for which nanostructuration has been reported to reduce the thermal conductivity by a factor of 10.

In order to understand the changes in thermal transport, we will combine macroscopic measurements of transport coefficients, and in particular thermal diffusivity, with microscopic measurements of the velocity and lifetime of the acoustic phonons, which mostly carry heat in these systems. This will allow us to track modifications in the individual properties of the phonons due to the nanostructuration and explain how such modifications act on thermal transport.

The individual properties of the phonons in a frequency range of ~10 GHz will be investigated by means of Laser Ultrasonics, a technique which is available in the FemtoNanoOptics group, where a phonon wave can be coherently excited in a material through a femtosecond laser pulse. Thermal diffusivity will be measured with a thermoreflectance equipment in the Energy group.

The Trainee will participate to experiments with Laser Ultrasonics and Thermoreflectance and to the analysis of the signals and their interpretation. Theoretical modeling for relating the Laser Ultrasonics signal to the individual properties of the phonon will be assured by A. Crut in the FemtoNanoOptics group.

This internship is meant to continue with a PhD thesis.