

THERMAL TRANSPORT IN ADVANCED GETE NANOSTRUCTURES FOR MEMORY APPLICATIONS

LABORATORY : Institut Lumière Matière

LEVEL : M1 / L3
TEAM(S) : ENERGIE

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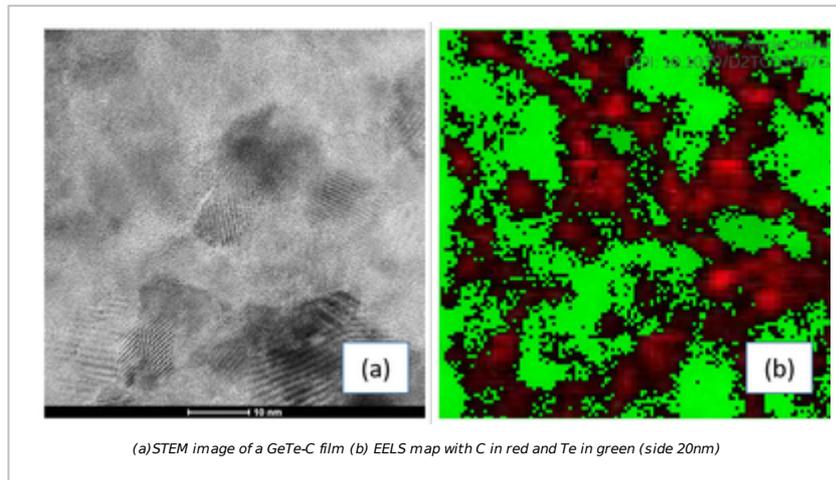
KEYWORD(S) : thermal transport / nanostructuration / pump-probe spectroscopy

SCIENTIFIC CONTEXT :

This project aims at understanding thermal transport in nanostructured thin films, of interest for solving the ubiquitous issue of thermal management.

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 reduce heat transport with no effect on other functional properties. In this project we are interested to materials which are used in phase change resistive memories, specifically GeTe. The change from a crystalline to an amorphous phase is accompanied by a huge contrast of electrical properties, which can be used to code and read information. To induce the phase change, Joule heating from electrical currents is used. However, the large programming currents needed to induce amorphisation are a source of a large heat dissipation. To reduce it, nanostructuration is a promising strategy allowing to reduce the crystalline thermal conductivity and thus to increase the Joule heating efficiency.



MISSIONS :

The trainee will investigate thermal transport in GeTe nanocomposites made of crystalline nanograins of GeTe surrounded by amorphous carbon (GeTe-C). Samples are prepared and characterized at the CEA-LETI in Grenoble. Previous works have demonstrated an effective thermal conductivity reduction in these samples at room temperature[1]. The trainee will use the pump-probe thermoreflectance technique to probe thermal transport in GeTe-C thin films as a function of temperature. To do so, he/she will probe several thicknesses for a given nanocomposite, in order to extract the GeTe-C layer thermal conductivity, disentangling it from the contributions from substrate and interfaces. The results will be compared on previous results on pure GeTe, and the temperature dependence will be analysed at the light of the possible microscopic mechanisms reducing heat transport (phonon scattering from defects/ interfaces...).

OUTLOOKS :

For a M2 internship, there is possibility to continue with a PhD

BIBLIOGRAPHY :

[1] R. Chahine, M. Tomelleri, J. Paterson, M. Bernard, N. Bernier, F. Pierre, D. Rouchon, A. Jannaud, C. Mocuta, V. M. Giordano, F. Hippert and P. Noé, *J. Mater. Chem. C*, 2022, DOI: 10.1039/D2TC03567G