Understanding thermal properties of GeTe and the effect of nanostructuration: towards energy harvesting in microelectronics

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Résumé

Heat management in microelectronics and the recycling of energy is a challenge in today's society. The study of the thermal properties of chalcogenide phase-change materials (PCMs) such as the prototypical GeTe compound will allow to improve and optimize future phase-change memories even if the latter are already mastered by industrials. To achieve this improvement reducing the thermal conductivity of the semiconducting PCM is a key tool. Obtaining a polycrystalline PCM with a thermal conductivity as low as possible can be achieved by the nanostructuration of the PCM in order to increase phonon scattering and block the phonon propagation. By this mean we can impact thermal transport properties without detrimental effect on the electronic transport properties.
In this experimental work, we first investigate thermal properties of crystalline GeTe, prior to any nanostructuration, providing an upper limit for the thermal conductivity of nanostructured GeTe, and of amorphous GeTe, whose thermal conductivity should represent the lowest possible reachable value.

In order to do so, we have developed a sensitive differential 3-omega method adapted for measurements on electrically conductive semiconducting thin films; this method permits to perform thermal conductivity measurement. Here I will present my first results on thermal conductivity of crystalline GeTe as a function of temperature, allowing to identify the dominant phonon scattering mechanism in this material in the temperature range investigated.
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Mots-Clés: Thermal conductivity, Germanium Telluride, Phonon

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