Multiscale thermal characterization of different systems types

Georges Hamaoui*, Nicolas Horny, and Mihai Chirtoc

GRESPI, Multiscale Thermophysics Lab.
Université de Reims Champagne-Ardenne URCA,
Moulin de la Housse BP 1039, Reims 51687, France

*Georges.hamaoui@univ-reims.fr

This decade witnessed a big advancement in technologies within each field of study (physics, chemistry, engineering, electronics…). The race of finding better component is at its peak. Researchers are focusing on making better materials or couple of materials with enhanced thermal/electrical properties for nano- and micro- electronic devices. These investigations aim to reduce heat losses in these device types and transform it to electricity for a better usage in thermoelectricity [1]. The materials in question can be a simple micrometer layer or a complicated nanometric layers or even membranes. Proper experimental techniques are then necessary to study the thermal properties of these new materials. In this study a characterization of thermal properties for different type of materials is made using a contactless method based on the measuring of emitted infrared (IR) radiations. These methods use Max Planck's principle to measure the IR radiations emitted from a material after being heated. Two types of photothermal radiometry (PTR) setups are present in the GRESPI lab [2]–[4]. One uses a frequency domain modulation up to 10 MHz and one uses a hybrid frequency/spatial domain modulation with ~10 µm resolution and up to 10 MHz. By using these methods, it is possible to extract independent parameters like the thermal diffusivity and thermal effusivity of thin films, and the thermal boundary resistance R_{th} [4]–[6]. These two setups are used jointly to characterize different type of material's combinations like:

- Phase changes materials,
- Metal/semiconductor or metal silicide/semiconductor couples,
- Organic materials,
- Irradiated graphite.

The results will help for a better understanding of thermal transport in these materials, and encourages novel ways to use them in diverse applications in different field of research.

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