New Development of the Flash Technique to Measure the Thermal Effusivity of Solids

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Characterizing the thermal transport properties of a material requires the knowledge of two independent parameters: thermal diffusivity (*D*) and thermal effusivity (*e*) (or thermal conductivity). The flash method has become a standard one to measure thermal diffusivity. It consists of heating the front face of an opaque plate by a brief light pulse and analyzing the temperature evolution at its rear surface or at the illuminated surface. However, the flash method applied to free standing plates only provides its thermal diffusivity, since the thermal effusivity is correlated to the energy absorbed by the sample surface that cannot be easily determined. To overcome this drawback we propose to bring the rear surface of the plate in contact with a fluid backing. In this way, the front surface temperature will be sensitive to the thermal mismatch between plate and fluid that is governed by their effusivity ratio. Following the idea of using a fluid for thermal contrast, we propose in this work using the flash method in the front configuration to obtain diffusivity and effusivity simultaneously in a fast manner. We have first calculated the front surface temperature of an opaque plate in contact with a fluid after being illuminated by a brief light pulse. The effect of the finite duration of the laser pulse as well as the heat losses by convection and radiation are also included in the model. It is shown that the sensitivities of the front surface temperature to *D* and *e* are uncorrelated (non-proportional). Then, in order to verify the validity of the method and to set its application limits we have performed flash measurements, using a pulsed laser and an infrared camera, on several calibrated materials, covering a wide range of thermal transport properties, taking as backing material water and ethanol.