ON THE HEATING MODULATION FREQUENCY DEPENDENCE OF THE PHOTOPYROELECTRIC SIGNAL IN EXPERIMENTS FOR LIQUID THERMAL CHARACTERIZATION

E. Marín [†], A. García, G. Juárez, J. A. Bermejo-Arenas, A. Calderón

Centro de Investigación en Ciencia Aplicada y Tecnología Avanzada, Instituto Politécnico Nacional, Legaria 694, Col. Irrigación, C.P. 11500, México D.F., México

R. Ivanov

Facultad de Física, Universidad Autónoma de Zacatecas, Calz. Solidaridad Esquina Paseo de la Bufa s/n, C. P. 98060, Zacatecas, Zac., México.

A Cruz-Orea

Departamento de Física, CINVESTAV-IPN, Av. IPN No. 2508, Col. San Pedro Zacatenco, CP 07360,

México D.F., México

ABSTRACT

A pyroelectric sensor can be seen as a layered system consisted on a pyroelectric material sandwiched between two thin metal layers acting as electrical contacts for measurements of the voltage drop that can be induced by heating. This kind of sensor can be used as a detector of electromagnetic radiation but also for thermal characterization of materials using the photopyroelectric technique. In this work we perform a theoretical analysis based in the so-called thermal wave approach to show that, when this sensor is heated periodically by the absorption of intensity modulated light by one of the metalized surfaces, while the other metal surface is in contact with a liquid sample, the resulting pyroelectric voltage signal amplitude enhances respecting the one resulting from the bare sensor, for certain values of the modulation frequency. This contradicts the intuitively expectation based in the assumption that the sample provides a new channel for heat conduction, thereby decreasing the pyroelectric temperature. We will show that the back and forth propagation and the superposition of thermal waves through the metal coatings must be taken into account in order to explain the observed behavior. The proposed model was experimentally tested for water and glycerin samples, and using a polyvinylidene difluoride (PVDF) polymer film, with Ni-Cu metal electrodes, as a pyroelectric sensor.

Key words: *Photopyroelectric technique, photoacoustic, thermal waves, heat transfer, thermal effusivity*
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[†] Corresponding author. Email: emarin63@yahoo.es