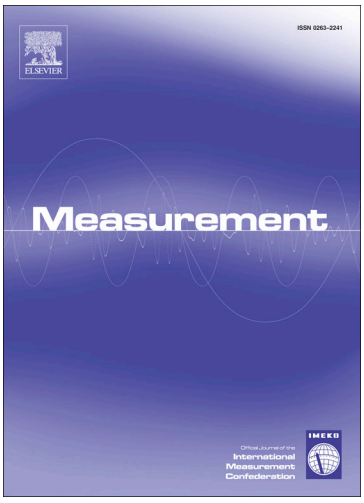

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Thermal effusivity measurements of thermal insulators using the photopyroelectric technique in the front configuration

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Abstract

In the photopyroelectric (PPE) technique in the front configuration one surface of a pyroelectric sensor is illuminated by a modulated laser beam, whereas the other surface is in contact with the sample under study. A frequency scan of the PPE signal allows to measure the thermal effusivity of liquids. Recently, it has been applied to solid samples, by taking into account the effect of the thin grease layer used to guarantee the thermal contact between sample and sensor. In this work, we extend this method to address the challenge of measuring the effusivity of thermal insulators accurately. We have developed a complete model of the PPE signal generation, including heat losses by convection, radiation and conduction to the surrounding gas. Besides, very thin pyroelectric sensors are used since they enhance the sensitivity of the PPE signal to the sample effusivity. Moreover, the sample is placed directly in contact with the sensor, without using any coupling grease, to avoid polluting porous samples. PPE measurements on several thermal insulators (paper, cork, wood and foam) indicate that this method is well suited to retrieve the thermal effusivity of insulators precisely.

Keywords: thermal effusivity, photopyroelectric technique, photothermal techniques, thermal insulators