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Method for measurement of the thermal diffusivity in solids: Application to metals, semiconductors, and thin materials

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We present a method for determining the thermal diffusivity in opaque solids by means of an analysis of the photoacoustic phase signal at low modulation frequencies using the open-cell photoacoustic technique. We show for $f \leq (\pi/2)^2 f_c$, where f_c is the modulation frequency at which the thermal diffusion length matches the sample thickness, the photoacoustic phase signal can be written in linear form with the modulation frequency f . Then, obtaining the proportionality coefficient by fitting the experimental data, the thermal diffusivity of the sample can be determined. The advantage of this method is that it is realized in a range of modulation frequencies below those normally used, hence, the photoacoustic signal should be alone attributed to the mechanism of thermal diffusion. Moreover, the signal-to-noise ratio will be more reliable. This method was tested in some samples and it is also shown to be important in solids with high diffusivity values and thin materials. © 1998 American Institute of Physics.

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thermal diffusivity, semiconductors, metals, thermal conductivity measurement, photoacoustic effect

PACS**07.20.-n**

Thermal instruments and apparatus

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Nonelectronic thermal conduction and heat-pulse propagation in solids; thermal waves

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Thermoacoustics, high temperature acoustics, photoacoustic effect

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