Thermal characterization of two-layer systems by means of periodic and pulsed laser heating

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Periodic and pulsed photothermal techniques provide useful methods based on linear relations between measurable quantities to obtain the thermal diffusivity and thermal conductivity of homogeneous materials. In this work, the effective thermal parameters of two-layered films are defined starting from an homogeneous layer which at the surfaces, produces the same temperature fluctuations and the same photothermal signal that the composite heated by a fast pulse or periodic-laser. Our theoretical model predicts that the effective thermal parameters of the layered system can only be calculated in the limit when the laser pulse duration is smaller tan the characteristic time of each layer respectively meanwhile the effective thermal parameters are well defined using a chopped incident laser radiation. The temperature distribution is calculated in each layer by using the Fourier integral and the time-dependent one-dimensional heat diffusion equation with appropriate boundary conditions according to the experimental conditions. Within this approximation, we found an analytical expression for both, the effective thermal diffusivity and thermal conductivity which depend significantly on the thickness and the thermal parameters of each film.