Thermal Diffusivity Measurements of a Composite Material with Orthogonal Anisotropy

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Although the flash method was primary developed for the measurement of homogeneous isotropic opaque solids, it has been successfully applied for an estimation of anisotropic materials (composites) [1]. The most simple, one-dimensional approach consists of measuring various samples of test materials prepared and experimentally arranged, so that the heat flows along the principal axes of the material. In the radial flash method technique, the sample front face is irradiated partially, i.e., when there is cylindrical symmetry, a central front face circular area of the sample, with a radius smaller then the sample radius, or a square area, for measurements of orthotropic materials with three mutually orthogonal thermal diffusivities, is irradiated. The thermal diffusivities are calculated by analyzing the temperature rise vs. time evolution measured simultaneously on the surface of the sample in various positions.

The paper concentrates on the measurement of anisotropic materials with orthogonal anisotropy and three mutually orthogonal thermal diffusivities [2]. The work utilizes a theory that describes the thermal behavior of a composite material with orthogonal anisotropy under initial and boundary conditions that conform to the real flash thermal diffusivity experiment [3]. It takes into account pulse heating over the rectangular area of the front face of a wall-shaped three-dimensional orthotropic composite material. The theory also takes heat losses from the front and rear faces into account.

The paper presents the data reduction method that allows us to estimate the thermal diffusivities in all three principal axes. The results of an experimental design analysis are discussed here, as well.

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[3] L. Voza, J. Gregus Š. Valovic, and W. Hohenauer, *Thermal Behaviour of a Composite Material with Orthogonal Anisotropy*, In: Proc. Thermal Conductivity 27 and Thermal Expansion 15 Symp., (Lancaster, DEStech Publications, 2003) 393.