Determination of Transient Thermal Interfacial Resistance between Two Bonded Metal Bodies Using the Laser Flash Method and the Parameter Estimation Technique

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This paper presents the results of measurements of the transient thermal interfacial resistance between two metal bodies bonded by three different adhesives in common use, i.e. by epoxy, cyanoacrylate, and silicon cement. Experimental data have been obtained using a standard technique for thermal diffusivity measurements, the laser flash method, while the data reduction was done with an efficient and reliable computational procedure based on the parameter estimation technique.

In the first section, the complete analytical solution of one-dimensional transient heat conduction through a three-layer system implying heat loss, thermal resistance at metal-adhesive contacts, and finite laser pulse duration, is presented. Besides this general solution, two simplified models which are used in this research, where the influence of some parameters has been neglected, are also given. The conditions for using these solutions in practice are described.

The second section presents the analysis of sensitivity coefficients of all parameters involved in the physical model. Taking into consideration the finite uncertainties of known parameters, it also provides possibilities of estimation of unknown parameters for different models and parametric values.

Information on samples, experimental setup, and final results, as well as their discussion, is contained in a separate section of the paper. The thermal interfacial resistance has been determined for the system of two identical thin copper disks joined together with each of the three above mentioned standard adhesives. Results on thermal interfacial resistance are presented in the function of the adhesive material, the thickness of the adhesive layer, and the choice of the physical model used for data reduction.