UNIVERSITI PUTRA MALAYSIA

CONSTRUCTION OF FLASH METHOD FOR DETERMINING THERMAL DIFFUSIVITY OF SOLIDS

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of requirement for the degree of Master of Science

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In this study, flash method was employed in determining thermal diffusivity of solids at room temperature. This method is applicable to any flash apparatus (in this study we used Minolta Photoflash) using a setup similar to the one presented by Parker et al.. The first part of the study is undertaken to calibrate the setup with a sample of known thermal diffusivity. The results clearly indicate that the thermal diffusivity of the calibration sample correlated well with the results from literature. Apart from that, a data acquisition system that simulate the front panel of an oscilloscope is developed using LabView RT 5.1, a graphical programming language for acquiring experimental data.

For practical purposes, we assume that the boundary conditions of the method are obeyed. Two data reduction methods, the conventional method and the iterative procedure were employed in determining the thermal diffusivity. The conventional method (correction of finite pulse time effect, non-uniform heating and heat loss)

was the commonly used method to determine the thermal diffusivity. However, the latter was found to allow one to determine thermal diffusivity with good accuracy without the need to normalize the non-dimensional curve and determine the $t_{1/2}$ manually.

The second part of the study involves the testing of the setup with rubber and superconductor sample. The effect of carbon black was investigated in SMR-5, ENR-25 and ENR-50. It is found that the thermal diffusivity increase with the increased in carbon black content for all three rubber samples. Study on the effect of epoxidation was also carried out. Since, the variation of thermal diffusivity cannot be concluded, an attempt to determine the crystallinity from the X-ray diffraction was carried out to assist in explaining the changes. The experimental results indicate that as the level of epoxidation increases the thermal diffusivity decreases for rubber without carbon black and the thermal diffusivity increases for rubber with carbon black as suggested by its crystallinity. In addition, the role of samarium doping in causing differences in the nature of thermal diffusivity for Bi-based superconductor was also reported. It is found that thermal diffusivity decrease with the increase in samarium.

It is recommended that future research and development be carried out to fully automate the whole sequence of thermal diffusivity measurements for both room and high temperature.