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Laser flash method

Introduction

The laser flash technique is a transient method for evaluating the thermal diffusivity (α) of a wide range of materials, developed by Parker et al. in 1961 [1]. The advantages of this method are: small samples with a simple geometry (disk shape), fast measurements (generally a few seconds at room temperature) and ease of handling. The thermal conductivity (λ) can be then calculated with Equation (1):

$$\lambda = \alpha c_p \rho \qquad (1)$$

where c_p is the specific heat capacity and ρ is the density.

Sample Preparation

Cylindrical shape samples of 10 mm in diameter are drilled from a refractory brick (Figure 1). The carrot is then cut in small pieces of 2 mm in thickness. Huge attention is paid in order to have two parallel faces. A graphite layer is added on the surface to increase the emissivity of the material during the measurements.

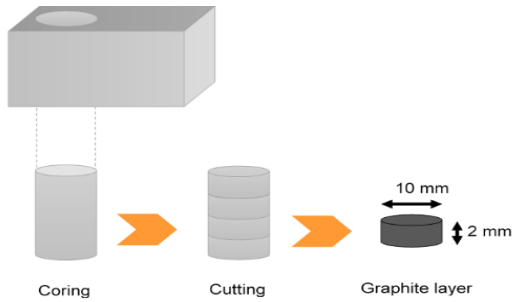

Figure 1 – Sample preparation

Test Procedure

The principle is to send a uniform energy pulse to impact on the front face of the sample (hot face). This high intensity energy diffuses throughout the material and an IR detector records the resulting time dependent temperature on the opposite face (cold face). A description of the procedure is shown in Figure 2. The thermal diffusivity is obtained taking into account the thickness of the sample and a characteristic time function, which describes the propagation of the heat from the hot face to the cold face. This function can be for instance Equation (2) called Parker's law:

$$\alpha_P = \frac{0.1388 \cdot z^2}{t_{0.5}} \qquad (2)$$

where z is the thickness of the sample and $t_{0.5}$ is the time required for the temperature rise to reach 50% of the maximum temperature.

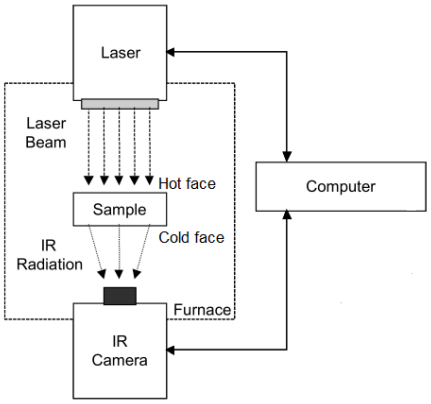

Figure 2 – Experimental setup.

Expected Result

Figure 3 shows the characteristic curve obtained with this method. Later on, the thermal diffusivity and the thermal conductivity are respectively evaluated using Equation (2) and (1).

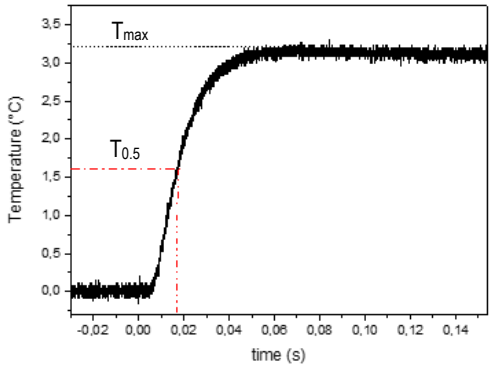

Figure 3 - Expected results.

Acknowledgments

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References

[1] W. J. Parker, R. J. Jenkins, C. P. Butler, and G. L. Abbott, "Flash method of determining thermal diffusivity, heat capacity, and thermal conductivity," *J. Appl. Phys.*, vol. 32, no. 9, pp. 1679–1684, 1961.

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