



**UNIVERSITI PUTRA MALAYSIA**

**THERMAL DIFFUSIVITY OF GLASS CERAMIC SYNTHESIZED  
FROM SODA LIME AND COAL FLY ASH**

**NORFAREZAH HANIM BINTI EDROS**

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FROM SODA LIME AND COAL FLY ASH**

**By**

**NORFAREZAH HANIM BINTI EDROS**

**Thesis Submitted to the School of Graduate Studies,  
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for the Degree of Master of Science**

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fulfilment of the requirement for the degree of Master of Science

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**Chairperson : Associate Professor Zaidan Abdul Wahab, PhD**

**Faculty : Science**

Glass ceramics are polycrystalline materials of fine microstructure that are produced by the controlled crystallization of a glass. The previous review of other researchers revealed that knowledge and expertise has been accumulated on the process of transformation of silicate waste into useful glass ceramic products. The aim of this research is to study the thermal diffusivity of a glass ceramic made from a mixture of soda lime silica and coal fly ash. The effect of sample compression pressure, sintering temperature and sample composition on the thermal diffusivity value was investigated in detail. All samples were measured using the Laser Flash Apparatus (LFA), X-Ray Fluorescence (XRF), Scanning Electron Microscopy (SEM) and X-ray Diffraction (XRD).

It was found that the thermal diffusivity value of the samples is dependent on the pressure, sintering temperature and sample composition. Higher sintering



temperature, coal fly ash content and compression pressure resulted in higher thermal diffusivity value. The experimental results showed that the thermal diffusivity value is in the range of 0.102 mm<sup>2</sup>/s to 0.858 mm<sup>2</sup>/s. As the ambient temperature increased from room temperature up to 300°C, the thermal diffusivity values were also increased. This suggests that thermal diffusivity is basically influenced by phonon interaction that determines the phonon mean free path.

The density value and linear shrinkage increase as the coal fly ash content and sintering temperature increased. XRD results revealed the formation of Diopside (CaMgO<sub>6</sub>Si<sub>2</sub>) and Wollastonite (CaSiO<sub>3</sub>) phases.



Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia  
sebagai memenuhi keperluan untuk ijazah Master Sains

**KADAR KERESAPAN HABA BAGI KACA SERAMIK SINTESIS  
DARI SODA KAPUR DAN ABU TERBANG ARANG BATU**

Oleh

**NORFAREZAH HANIM BINTI EDROS**

**Oktober 2010**

**Pengerusi : Profesor Madya Zaidan Abdul Wahab, PhD**

**Fakulti : Sains**

Kaca seramik merupakan bahan polihablur halus yang dihasilkan oleh aktiviti penghabluran kaca yang terkawal. Kajian terdahulu oleh para penyelidik mendedahkan bahawa pengetahuan serta kemahiran telah digabungkan dalam proses transformasi sisa kaca kepada produk kaca seramik. Sasaran kajian ini adalah untuk mengkaji kadar keresapan haba bagi kaca seramik dengan campuran yang terdiri daripada soda kapur silika dan abu terbang arang batu. Pengaruh tekanan yang dikenakan pada sampel, suhu persinteran dan komposisi sampel terhadap kadar keresapan haba dikaji secara terperinci. Semua sampel diukur dengan menggunakan Laser Flash Apparatus (LFA), X-Ray Fluorescence (XRF), Scanning Electron Microscopy (SEM) dan X-ray Diffraction (XRD).



Didapati bahawa nilai kadar kerosapan haba yang didapati adalah bergantung pada tekanan terhadap sampel, suhu persinteran dan komposisi sampel. Lebih tinggi suhu persinteran, jumlah kandungan abu terbang arang batu dan tekanan yang diberikan terhadap sampel, lebih tinggi kadar kerosapan haba. Keputusan kajian menunjukkan bahawa nilai kadar kerosapan haba didapati di dalam julat  $0.102 \text{ mm}^2/\text{s}$  hingga  $0.858 \text{ mm}^2/\text{s}$ . Apabila suhu persekitaran meningkat daripada suhu bilik sehingga mencapai  $300 \text{ }^\circ\text{C}$ , nilai kadar kerosapan haba juga meningkat. Ini menunjukkan bahawa kadar kerosapan haba pada dasarnya dipengaruhi oleh interaksi fonon yang menentukan jarak bebas purata fonon.

Nilai ketumpatan dan pengecutan linear meningkat apabila kandungan abu terbang arang batu dan suhu persinteran meningkat. Keputusan XRD menunjukkan pembentukan fasa Diopside ( $\text{CaMgO}_6\text{Si}_2$ ) dan Wollastonite ( $\text{CaSiO}_3$ ).

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

**Zaidan Abdul Wahab, PhD**

Associate Professor  
Faculty of Science  
Universiti Putra Malaysia  
(Chairman)

**Maarof H. A Maksin, PhD**

Professor  
Faculty of Science  
Universiti Putra Malaysia  
(Member)

**Khamirul Amin Matori, PhD**

Faculty of Science  
Universiti Putra Malaysia  
(Member)

---

**HASANAH MOHD GHAZALI, PhD**

Professor and Dean  
School of Graduate Studies  
Universiti Putra Malaysia

Date:





## DECLARATION

I declare that the thesis is my original work except for quotations and citations, which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Putra Malaysia or other institutions.

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**NORFAREZAH HANIM BINTI EDROS**

Date: 11 October 2010



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