Paper B4

Local silica sand deposits and their utilisation in producing cordierite glass-ceramics

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Three silica sand deposits (Bintulu, Terengganu and Perak ex-mining land) were used as a raw material in producing cordierite glass-ceramics ($MgO\text{-}Al_2O_3\text{-}SiO_2\text{-}TiO_2$). The crystallization sequences of $MgO\text{-}Al_2O_3\text{-}SiO_2\text{-}TiO_2$ system glass were studied by means of differential thermal analysis (DTA), X-ray diffraction (XRD) and fiel emission scanning electron microscopy (FESEM). The base glass had a composition of 45.00% SiO_2, 24.00% Al_2O_3, 15.00% MgO and 8.50% TiO_2 as the nucleating agent. The procedure for the preparation of the cordierite glass-ceramic material included glass melting, forming, annealing and heat treatment. From the DTA results, the crystallization temperature was found to start around 800ºC~ 900ºC. The XRD analysis of the glass-ceramics indicated that the cordierite phase became more dominant for the Bintulu silica sand compared to the Terengganu and Perak ex-mining land deposits. The coefficien of thermal expansion (CTE) results showed that the Bintulu glass-ceramics had lower thermal expansion compared to the glass-ceramics using Terengganu and Perak ex-mining land deposits. The Vickers micro-hardness result of the Bintulu, Terengganu and ex-mining revealed that increasing the heat-treatment temperature results in a slightly increase of the hardness values. Based on the XRD results, the Bintulu and Terengganu silica sand deposits can be used as SiO_2 source for producing cordierite glass-ceramics without any further chemical upgrading. Here it also clear that the ex-mining silica sand deposit does not have the purity level required to have the same performance as Bintulu and Terengganu deposits without further improvement

Tiga deposit pasir silika (Bintulu, Terengganu dan bekas lombong Perak) telah digunakan sebagai bahan mentah untuk penghasilan kaca-seramik kordierit ($MgO\text{-}Al_2O_3\text{-}SiO_2\text{-}TiO_2$). Aturan penghabluran sistem kaca ($MgO\text{-}Al_2O_3\text{-}SiO_2\text{-}TiO_2$) telah dikaji dengan menggunakan alat analisis pembezaan terma (DTA), pembelauan X-ray dan FESEM. Kaca asas mempunyai komposisi 45.00% SiO_2, 24.00% Al_2O_3, 15.00% MgO dan 8.50% TiO_2 sebagai agen penukleusan. Prosedur penyediaan bahan kaca-seramik kordierit termasuk peleburan, pembentukan, penyepuhlindapan dan rawatan haba kaca. Daripada keputusan DTA, suhu penghabluran diadapati bermula sekitar 800ºC~ 900ºC. Analisis XRD kaca-seramik mendapati fasa kordierit menjadi lebih dominan bagi pasir silika Bintulu berbanding dengan deposit Terengganu dan bekas lombong Perak. Keputusan ujian pekali pengembangan haba (CTE) menunjukkan kaca-seramik Bintulu mempunyai pengembangan haba yang rendah berbanding dengan kaca-seramik Terengganu dan bekas lombong Perak. Keputusan ujian micro-kekerasan Vickers Bintulu, Terengganu dan bekas lombong Perak mendedahkan bahawa peningkatan suhu rawatan haba akan sedikit meningkatkan nilai kekerasan. Berdasarkan kepada keputusan –keputusan XRD yang telah didapati, deposit pasir silika Bintulu dan Terengganu mempunyai potensi untuk digunakan sebagai sumber SiO_2 bagi penghasilan kaca-seramik kordierit tanpa melalui proses tambah nilai secara kimia. Kajian ini juga membuktikan bahawa deposit pasir silika bekas lombong tidak mempunyai tahap ketulenan yang diperlukan seperti untuk memiliki prestasi yang serupa deposit Binyulu dan Terengganu tanpa tambah nilai lanjut.

Warta Geologi (Newsletter of the Geological Society of Malaysia), Vol. 36, No. 2, April-June 2010