STUDY ON ELECTRICAL AND STRUCTURE PROPERTIES OF METAKAOLIN GEOPOLYMER/CARBON NANOFIBERS (CNFs) NANOCOMPOSITE

SLB0003-SG-2012

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2015

ABSTRACT

Geopolymer based nanocomposites have received much attention from scientists and researchers due to their superior properties to conventional materials, and it can be produced by incorporating nanosized particle into a standard matrix material. To create a novel nanocomposite, metakaolin-geopolymer reinforced with different percent of carbon nanofibers (CNFs) were prepared and characterized by using Electrochemical Impedance Spectroscopy (EIS), X-Ray Diffraction (XRD), Fourier Transform Infrared Spectroscopy (FTIR) and Scanning Electron Microscope (SEM). The metakaolin geopolymers were produced by mixing the alkaline activator contains of 10 M of sodium hydroxide (NaOH) and 8M of sodium silicate (Na_2SiO_3) and subsequently reinforced with 1.0% and 2.0%. Samples without CNFs (0.0%) also prepared as a control. The CNFs / Metakaolin Geopolymer based nanocomposites sintered at temperature of 700 ^{0}C, 800 ^{0}C, 900 ^{0}C and 1000 ^{0}C. The conductivities of nanocomposites were found in the range of 2.60×10^{-5} $\Omega^{-1}.cm^{-1}$ to 2.91×10^{-5} $\Omega^{-1}.cm^{-1}$ and the highest conductivity was at 2.0% of CNFs which sintered at 800 ^{0}C. Results from XRD showed that nepheline phases formed at temperature of 900 ^{0}C and 1000 ^{0}C. The crystallite size of CNF/metakaolin nanocomposite decreases when the sintering temperature rises from 800-1000°C. FTIR analysis has exhibited strong bands of IR in range of 723 cm^{-1} to 1010 cm^{-1} which are ascribed to symmetric stretching of Si-O-Si and Si-O-Al. Based on SEM observation, the carbon nanofibers were not well dispersed within the geopolymer and this is probably due to the agglomeration of CNFs itself.

Keywords: metakaolin, geopolymer, carbon nanofibers

KAJIAN SIFAT ELEKTRIK DAN STRUKTUR KOMPOSITNANO GEOPOLIMER METAKAOLIN/CARBON NANOFIBERS (CNFs)

ABSTRAK

Kompositnano berasaskan geopolimer telah mendapat perhatian ramai daripada saintis dan penyelidik disebabkan sifat-sifatnya yang lebih baik berbanding bahan konvensional dan ini dapat dihasilkan dengan mengabungkan partikel nano ke dalam bahan geopolimer biasa. Untuk menghasilkan novel kompositnano, geopolimer metakaolin dicampurkan dengan peratusan carbon nano fibers (CNFs) yang berbeza dan disediakan dan sifatnya dikaji menggunakan beberapa teknik seperti Electrochemical Impedance Spectroscopy (EIS), X-Ray Diffraction (XRD), Fourier Transform Infrared Spectroscopy (FTIR) and Scanning Electron Microscope (SEM). Geopolimer metakaolin dihasilkan dengan mencampurkan pengaktif alkali yang mengandugi 10 M Natrium Hidroksida (NaOH) dan 8 M Natrium Silikat (Na2SiO3) dan kemudiannya dicampurkan dengan CNFs pada 1.0% dan 2.0%. Sampel kawalan iaitu tanpa campuran CNFs juga disediakan. Kompositnano Geopolimer Metakaolin kemudiannya disinter pada suhu 700 0C, 800 0C, 900 0C dan 1000 0C. Didapati kekonduksian kompositnano adalah dalam julat 2.60x10-5 Ω-1.cm-1 to 2.91x10-5 Ω-1.cm-1 dan kekonduksian tertinggi dicatatkan pada sampel dengan 2.0% CNFs dengan suhu sinteran 800 0C. Keputusan XRD menunjukkan fasa nepheline terhasil pada suhu 900 0C dan 1000 0C. Saiz hablur kompositnano didapati berkurang dengan peningkatan suhu sinteran. Analisis FTIR menunjukkan jalur yang kuat pada julat 723 cm-1 sehingga 1010 cm-1 yang mewakili regangan simetri ikatan Si-O-Si and Si-O-Al. Melalui pemerhatian SEM, didapati carbon nanofibers (CNFs) tidak tersebar dengan baik dalam matriks geopolimer dan berkemungkinan disebabkan oleh algomerasi CNFs.