INVESTIGATION OF THERMOPHYSICAL PROPERTIES OF TERNARY NITRATE BASED PHASE CHANGE MATERIAL INDUCED WITH MXENE AS NOVEL CLASS OF NANOCOMPOSITES

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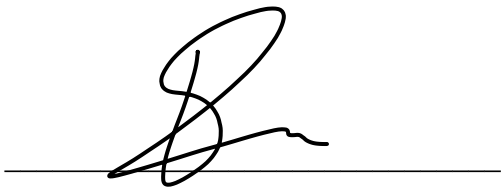

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ABSTRAK

Teknologi Janakuasa Tenaga Solar Berkonsentrasi (CSP) dikenal pasti sebagai sumber tenaga yang boleh diperbaharui dan bersih. Penyimpanan tenaga termal (TES) yang banyak digunakan dalam teknologi ini memerlukan sifat termofizik yang baik untuk penggunaan teknologi yang optimum. Garam cair, iaitu garam tak organik digunakan sebagai TES kerana kemampuannya beroperasi pada suhu tinggi. Namun begitu, garam cair mempunyai takat lebur yang tinggi dan kapasiti penyimpanan tenaga haba yang rendah. Dalam tesis ini, nanokomposit baru yang mengandungi nitrat terner yang dicampurkan dengan MXene menggunakan kaedah dua langkah. $LiNO_3$-$NaNO_3$-KNO_3 dengan nisbah jisim (35:10:55) dan (35:12:53) digunakan sebagai dua sampel garam cair nitrat tulen dan dicampurkan dengan MXene dalam berat 0.2, 0.5, 1.0, dan 1.5 peratus. Sifat morfologi dan termofizik nanokomposit baru ini dikaji dengan menggunakan Scanning Electron Microscope (SEM), Energy Dispersive X-Ray Analysis (EDX), Fourier-transform infrared spectroscopy (FTIR), Thermal Gravimetric Analysis (TGA) dan Differential Scanning Calorimetry (DSC) . SEM dan EDX menunjukkan campuran itu dicampurkan dengan baik. DSC digunakan untuk mengukur entalpi dan titik lebur nanokomposit yang dihasilkan. Entalpi garam cair ternary tulen dengan nisbah jisim (35:10:55) dan (35:12:53) meningkat hampir 5.74 kali dan 1.6 kali, dengan penambahan 1.5% berat MXene pada setiap sampel. Hasil TGA menunjukkan bahawa sampel stabil dalam lingkungan julat suhu 600 - 730 °C. Dengan menambah Mxene dalam garam cair nitrat tulen, peningkatan dalam haba pendam tentu dapat dilihat. Nilai c_p tertinggi dijumpai apabila 1.5 wt% MXene dicampurkan dengan $LiNO_3$-$NaNO_3$-KNO_3 dengan berat 35:12:53% iaitu 1.84162 J/g.K. Dengan mengembangkan parameter fisiokimia dalam garam eutektik, potensinya untuk digunakan sebagai bahan nanokomposit dan kecekapan CSP meningkat.

ABSTRACT

Concentrated Solar Power (CSP) technology has been identified as an alternate renewable and clean energy source. Thermal energy storage (TES) system which is vastly used in this technology requires good thermophysical properties for an optimum usage of the technology. Molten salt, an inorganic salt has been used as TES due its ability to operate at high temperature. Unfortunately, molten salt has high melting point and low thermal storage capacity. In this thesis, novel class nanocomposites containing ternary nitrate based molten salt induced with MXene is developed using two step method. $LiNO_3$-$NaNO_3$-KNO_3 with the mass ratio of (35:10:55) and (35:12:53) are used as two pure ternary nitrate-based molten salt samples and doped with MXene in the wt.% of 0.2, 0.5, 1.0, and 1.5. Morphological and thermophysical properties of the new nanocomposites were studied using Scanning Electron Microscope (SEM), Energy Dispersive X-Ray Analysis (EDX), Fourier-transform infrared spectroscopy (FTIR), Thermal Gravimetric Analysis (TGA) and Differential Scanning Calorimetry (DSC). SEM and EDX shows the mixture were properly mixed. DSC is used to measure the enthalpy and melting point of the prepared novel nanocomposites. The enthalpy of pure ternary molten salt of the mass ratio of (35:10:55) and (35:12:53) is increased by almost ≈5.74 times and 1.6 times, respectively, by doping 1.5 wt.% of MXene in each. TGA result showed that the samples were stable in the temperature range of 600 - 730 °C. With the addition of MXene, enhancement in specific heat can be seen. The highest c_p value is found when 1.5wt% MXene is doped into $LiNO_3$-$NaNO_3$-KNO_3 of 35:12:53 wt.% which is 1.84162 J/g.K. Developing the physiochemical parameters in the eutectic salts enhances its potential to be used as nanocomposite material and hence increases the efficiency of CSP.

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