Thermal conductivity, reliability, and stability assessment of phase change material (PCM) doped with functionalized multi-wall carbon nanotubes (FMWCNTs)

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ABSTRACT

The thermal properties of Phase Change Material (PCM) can be altered by introducing nanoparticles, and composite formed from the addition of nanoparticles are termed Nano-Enhanced Phase Change Materials (NEPCM). In the present study, the enhancement of thermal conductivity and feasibility study of dispersing multi-walled carbon nano tubes (MWCNTs) and functionalized MWCNT (FMWCNTs) in various mass fractions (AFMW-0.1, AFMW-0.3, AFMW-0.5, AFMW-0.7, AFMW-1.0) into the Plusice A70 PCM were examined. Differential scanning calorimetry (DSC) and TEMPOS thermal analyzer measured the latent heat storage, melting temperature, and thermal conductivity of the nano PCM composite. The thermal conductivity measured for the prepared nanocomposite showed a 109.5% enhancement for 1.0 wt% of non-functionalized MWCNT and 150.7% enhancement for 1.0 wt% of functionalized MWCNT compared to pristine PCM's thermal conductivity. This statement concluded that 50% enhancement for a 1.0 wt% of functionalized MWCNT compared to non-functionalize MWCNT immersed in A70 PCM. The nano composite PCM was thermally stable up to 200 °C and no chemical reaction takes place between the base PCM and nanoparticles. The result shows that the microscopic structure remained stable for the nanocomposite while the optical transmittance reduced noticeably for the nanocomposite relative to pristine A70 PCM. It can be concluded, the prepared nano composite PCM may be useful for solar thermal, photovoltaic thermal system, and low concentrated photovoltaic thermal system applications.

KEYWORDS
Functionalization; NEPCMs; Organic PCM; Solar energy; Thermal conductivity

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