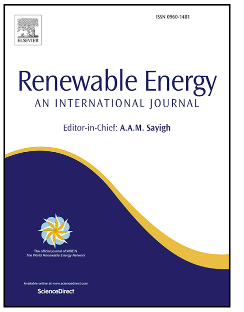

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Thermal-physical properties of nanoparticle-seeded nitrate molten salts

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Abstract

Molten salts have been used extensively as energy storing materials, however, their thermophysical properties, such as specific heat capacity and thermal conductivity have limited their applications. In this study, potassium nitrate and sodium–potassium nitrate ($NaNO_3$:KNO_3 with 60:40 molar ratio) are used as the base salts with different types of nanoparticles, which are iron oxide (Fe_2O_3), titanium dioxide (TiO_2) and copper oxide (CuO) over a wide range of temperatures up to 773 K. Laser flash analysis is used to measure thermal diffusivity and dynamic scanning calorimeter for specific heat (latent heat and melting temperature) of the molten salts and nanosalts. The addition of Fe_2O_3 into sodium–potassium nitrate salt increases thermal diffusivity up to 50%. Moreover, the highest increase in the latent heat reaches 14.45% at 1 wt. % CuO-binary nitrate salt. In addition, the total thermal energy storage of nanosalt increases up to 6% including both of sensible and latent heat. The formation of the interface layer between nanoparticles and salts could be the reason behind this enhancement in sensible and latent heats. The morphology of nanosalt measured by scanning electron microscopy showed a heterogeneous dispersion of nanoparticles, including agglomerated areas that could be sometimes responsible for the degradation of the performance.

Keywords: nanofluid, nitrate salt, specific heat capacity, latent heat, thermal energy storage, thermal diffusivity.