Experimental investigations on thermal properties of copper (II) oxide nanoparticles enhanced inorganic phase change materials for solar thermal energy storage applications

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ABSTRACT

Due to the current environmental catastrophe and energy crises, the government and industries shift towards sustainable, renewable, and clean energy sources. This circumstance motivates the harvesting of energy from all available sources. Phase change materials (PCM) are latent heat storage (LHS) substances and have been proven one of the potential techniques for thermal energy storage (TES). However, PCMs possess some disadvantages lies lower thermal conductivity, due to that the heat transfer and heat storage capacity are less. In this present work, feasibility and thermal conductivity enhancement of dispersing Copper (II) Oxide (CuO) nanoparticles in six various weight concentrations (0.1%, 0.5%, 1.0%, 2.0%, 3.0%, and 5.0%) into the salt hydrate PCM with Sodium dodecylbenzene sulfonate (SDBS) were analyzed. A two-step method is adopted for dispersing nanoparticles and PCM. The key objective of the research work is to characterize the elemental mapping, chemical stability, thermal stability, and thermal conductivity of developed CuO enhanced salt hydrate PCM. The Fourier transform infrared (FT-IR) spectroscopy shows the CuO nanoparticles integrated well, and no chemical reaction occurs with nanoparticles, and PCM means chemically stable. The thermogravimetric analysis (TGA) reveals that prepared composite salt hydrate PCM are thermally stable up to 474°C. Furthermore, the thermal conductivity was enhanced by 87.39% during the dispersion of 3.0wt%CuO nanoparticles into salt hydrate PCM. Thus, the newly developed nanocomposite PCM is potential material for medium and low-temperature solar TES applications.

KEYWORDS

Phase change materials; Thermal conductivity; Nano enhanced phase change materials; Thermal energy storage

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