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Investigation on Solar Thermoelectric Generator Using D-Mannitol/Multi-Walled Carbon Nanotubes Composite Phase Change Materials

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Abstract : The match of Solar thermoelectric generator (STEG) and phase change materials (PCM) can enhance the solar energy storage and reduce environmental impact from the day-and-night transformation and weather changes. This work utilizes D-mannitol (DM) matrix as the suitable PCM for coupling with thermoelectric generator to achieve the middle-temperature solar energy storage performance at 165℃-167℃. DM/MWCNT composite phase change materials prepared by ball milling not only can keep a high phase change enthalpy of DM material but also have great photo-thermal conversion efficiency of 82%. Based on the self-made storage device container, the effect of PCM thickness on the solar energy storage performance is further discussed and analyzed. The experimental results prove that PCM-STEG coupling system can output more electric energy than pure STEG system because PCM can decline the heat transfer and storage thermal energy to further generate the electric energy through thermal-to-electric conversion when the light is removed. The increase of PCM thickness can reduce the heat transfer and enhance thermal storage, and then the power generation performance of PCM-STEG coupling system can be improved. As the increase of light intensity, the output electric energy of the coupling system rises accordingly, and the maximum amount of electrical energy can reach by 113.85 J at 1.6 W/cm2. The study of the PCM-STEG coupling system has certain reference for the development of solar energy storage and application.

Keywords : solar energy, solar thermoelectric generator, phase change materials, solar-to-electric energy, DM/MWCNT
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