Nanoscale physics

An investigation on photovoltaic panel coupled with nanoparticle-enhanced phase change material

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The photovoltaic (PV) panel converts a proportion of solar radiation into electric and the remainder into heat which causes a rise of the temperature of cells of PV panel. The Increase in the cell temperature reduces the performance of PV panels and can accelerate long-term degradation [1]. The PV panel operating temperature is dependent on solar radiation, outdoor temperature, wind speed, panel materials and manufacturing technology [2]. There are different active and passive heat removal techniques to use solar cells at low operating temperature and protect solar cells from excessive heat. One of the novel passive methods is to utilize phase change materials (PCM). However, the thermal conductivity of PCM is relatively low which results in low heat transfer rate during melting and solidification process. In order to overcome this drawback, several techniques have been proposed such as the use of extended surfaces, heat pipes, micro encapsulating of PCM and dispersing highly thermal conductive nanometer-sized particles in PCM [3]. This study is focused on the use of nanoparticles to enhance heat transfer rate of phase change process. A finite difference code was developed to investigate the thermal behavior and electric energy conversion efficiency of a photovoltaic panel system coupled with nanoparticle-enhanced phase change material (NEPCM-PV).

1. *Browne M.C., Norton B., McCormak S.J.,* Phase change materials for photovoltaic thermal management //Renew Sust Energ Rev -2015. **-47**. –P. 762-782.
2. *Armstrong S., Hurley W.G.* A thermal model for photovoltaic panels under varying atmospheric conditions // Appl Therm Eng -2010. **-30.-**P. 1488-1495.
3. *Jegahheeswaran S., Pohekar S.D.* Performance enhancement in latent heat thermal storage system: A review // Renew Sust Energ Rev -2009. **-13**. –P. 2225-2244.