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The effect of different nanoshells on the solar–thermal conversion of microencapsulated phase-change material

Abstract. Solar-absorbing metamaterial can be used as an outside surface shell of microcapsules of phase-change materials (PCMs), to manipulate thermoregulation through solar–thermal conversion for heating up the PCM while taking advantage of latent heat that can be stored or released from the PCM over a tunable temperature range. To enable further modification of the performance of microencapsulated PCM for different applications, this paper presents a new design with one more layer of the shell added between the metamaterial outer surface and the PCM. The added shell can be made with Mg (AZ31), Ti-6Al-4V, Al, Cu or SS304. The effect of these different shell materials on the solar–thermal conversion of microencapsulated PCM is analysed and demonstrated. Different shell materials can be chosen to enhance high temperature-resistance, corrosion resistance, thermal conductivity and flame retardant capability in thermoregulating structures and in a variety of solar energy applications for such areas as construction, transportation and textiles. Such micro-microencapsulated PCMs may open up new routes to modify thermoregulating structures with novel properties and added value, and represent a breakthrough concept in solar energy conversion, thermal storage and novel thermoregulating technologies.

Keywords: microencapsulation, phase-change material, solar-absorbing metamaterial, solar–thermal conversion, thermal energy storage, thermoregulation

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