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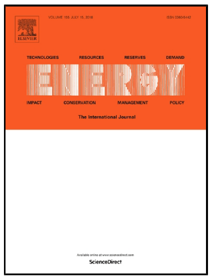

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A facile approach to synthesize microencapsulated phase change materials embedded with silver nanoparicle for both thermal energy storage and antimicrobial purpose

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Abstract: In this study, a facile approach having the advantages of high efficiency and low-energy consumption for synthesis of microencapsulated phase change materials (MicroPCMs) with thermal energy storage and antimicrobial properties was demonstrated. Phase change materials (PCMs) was firstly encapsulated via the photocurable pickering emulsion polymerization technique, and then followed by silver reduction. The resulting microcapsules exhibited an excellent spherical morphology, narrow particle size distribution and a well-defined core-shell structure. The chemical composition and surface elemental distribution of Ag/SiO_2-MicroPCMs were confirmed by the FTIR and EDS. The TEM observations indicated that Ag nanoparticles have been successfully attached on the surface of SiO_2 nanoparticles. In addition, the results obtained from DSC and TGA indicated that the microcapsules achieved a good latent-heat storage capability, enhanced thermal reliability and stability. More importantly, Ag/SiO_2-MicroPCMs was eventually combined with PVA hydrogel to prepare an antibacterial and thermoregulation composite material. As expected, the composite material obtained an excellent bactericidal properties, especially for Staphylococcus aureus. Furthermore, this composite material was also endowed with thermoregulation properties, due to the inherent latent heat storage characteristic of Ag/SiO_2-MicroPCMs. It can be concluded that the microcapsules developed in this work show great potential in applications for thermal energy storage, food preservation, wound dressing, and etc.

Keyword: Phase change materials; Microcapsules; Pickering emulsion; Thermal energy storage; Antimicrobial

1. Introduction

Microencapsulated phase change materials (MicroPCMs, diameter is 1-100 μm), often considered unique micrometer-scaled composites with a superior performance of latent heat thermal storage as compared with bulk PCMs, can reduce PCMs reactivity with the outside environment, enlarge heat transfer area and increase the heat transfer rate [1, 2]. The microcapsules which pack the PCMs core individually with a shell of macromolecules can therefore handle even liquids as a solid material [3]. Currently, there is a multitude of techniques for the microencapsulation of PCMs with different polymer shells through interfacial polycondensation [4], suspension polycondensation [5], in situ polycondensation [6] and complex coacervation [7]. Meanwhile, many types of synthetic polymer, such as melamine-formaldehyde resin [8], polyurea-formaldehyde resin [9], polystyrene [10], PMMA (poly(methylmethacrylate)) [11] and even biodegradable polymers like gelatin [12], are usually selected as a shell material. Nevertheless, the traditional well-

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