Sol-gel 공정을 통한 SiO_2 쉘과의 상이한 스테아산 비율의 합성 및 특성

Synthesis and Characteristics of Different Ratio of Stearic Acid with SiO_2 Shell Through Sol-Gel Process

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Abstract

The synthesis of stearic acid composite phase change material (PCM) was investigated and the samples produced were characterized for use in latent heat storage, using a simple chemical sol-gel process. The PCM was encapsulated to tetraethyl orthosilicate by various preparation ratios of stearic acid (5, 10, 15, 20, 30 and 50%). Fourier transformation infrared spectroscope (FT-IR) and X-Ray diffraction (XRD) were performed to determine the chemical structure and crystalloid phase of the microencapsulated PCM. SATEOS1 (5%) shows the best proportion for the PCM. With the presence of stearic acid as core materials and SiO2 as the supporting materials, it does not show any chemical reaction between both of them. SATEOS1 shows promising potential for thermal energy storage as it shows a better encapsulation efficiency and good thermal stability.

키 워 드 : 석산, 실리카 껍질, 열 에너지 저장, 미세 캡슐화
Keywords : stearic acid, silica shell, thermal energy storage, microencapsulation

1. Introduction

When environmental concerns are growing, the public awareness for efficient energy use in all type of sectors are increased. It is reported that approximately 58% of total energy consumption in residential and building sector is used for heating and cooling[1]. Besides, in residential and commercial buildings, thermal energy storage is an attractive solution for reducing energy demand. Thermal energy storage can easily integrate into the building envelopes for energy efficiency, which in turn reduces the environmental impact of high energy usage. In recent years, thermal energy storage technology has given rise to considerable concern as fuel energy shortages and environmental pollution are becoming increasingly prominent[2]. One of the most efficient ways to store thermal energy, latent heat storage gained outstanding attention as it offers high energy storage capacity with low temperature swing through the use of phase change materials (PCMs). Because of their high energy storage density and almost isothermal heat storage cycle, PCMs have attracted growing attention as one of the promising materials for thermal energy storage. Therefore, in present study, stearic acid was selected as core material for encapsulation using sol-gel process. Tetraethylorthosilicate(TEOS) is as an inorganic material contain SiO_2 which can encapsulate the stearic acid.

2. Materials and Method

Figure 1 shows the preparation method of the microencapsulated stearic acid with SiO_2 shell at different proportion (5, 10, 15, 20, 30 and 50%).

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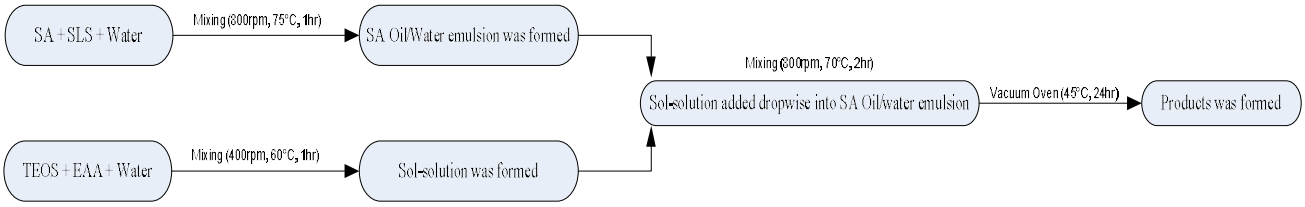
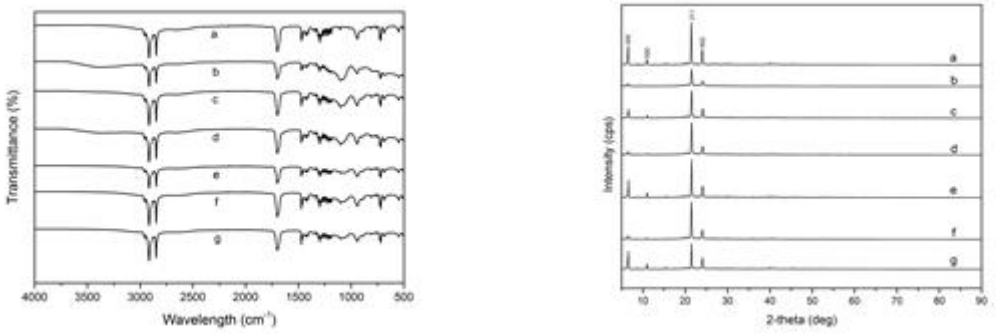


Figure 1. Preparation method

3. Results and Discussion

Figure 2 shows the FT-IR and XRD analysis for the microencapsulated stearic acid with SiO_2 shell at various proportion. FT-IR analysis shows that there is high peak and broad intensity at 1100 cm-1, correlated to the anti-symmetrical stretching vibration of Si-O-Si band. It concluded the formation of SiO_2 on the surface of stearic acid. Besides, XRD analysis concluded that the formation of SiO_2, which is an amorphous structure, decrease the crystallinity of the microencapsulated stearic acid. Thus, there is no chemical interaction between the stearic acid and SiO_2 shell and proven the effectiveness as thermal energy storage material.



(i) (ii)

Figure 2. Result of the (i) FT-IR spectra and (ii) XRD analysis of (a) SA, (b) SATEOS1 (5%), (c) SATEOS2 (10%), (d) SATEOS3 (15%), (e) SATEOS4 (20%), (f) SATEOS5 (30%) and (g) SATEOS6 (50%)

4. Conclusion

Microencapsulated stearic acid with SiO2 shell is a promising materials for thermal energy storage due to its stability.

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