졸겔 법을 통한 라우르산 기반의 상변화 물질의 합성

Synthesis of Lauric Acid Based Phase Change Materials Via Sol-gel Route

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Abstract

Lauric acid (LA) which is also known as dodecanoic acid has been selected as the phase change material (PCM) owing tc eco-friendly in nature. A systematic study has been conducted for encapsulation of LA (core) with silicon dioxide (SiO2) as shel material. Different core-shell ratio was chosen to microencapsulate the LA with 10 ml of tetraethyl orthosilicate (TEOS) as the precursor solution for the formation of SiO2. The synthesis of microencapsulated LA was carried out at 2.5 pH of precurso solution. The synthesized microencapsulated LA are characterized by Fourier transform infrared spectroscope (FT-IR) and X-Ray Diffraction (XRD) which confirmed the presence of SiO2 shell on the surface of LA.

키 워 드 : 라우르산, 실리카 껍질, 미세 캡슐화, 솔겔
Keywords : lauric acid, silica shell, microencapsulation, sol-gel

1. Introduction

Phase change materials (PCMs) as a thermal energy storage (TES) materials with high storage density can provide various solutions in different applications such as heating, cooling and thermal management [1]. PCMs are generally divided into three different categories which are organics (e.g., paraffins, fatty acids and esters), inorganic (e.g., salt hydrates and metallic alloys), and eutectics (mixtures of inorganics and/or organics). Among them, fatty acids (lauric acid) have desirable characteristics and properties viz. suitable melting temperature, low-supercooling, thermal and chemical stability, outstanding phase transition performance and non-toxicity. Thus, in present study, different amount of lauric acid (LA) i.e. 5 (LATEOS1), 10 (LATEOS2), 15 (LATEOS3), 20 (LATEOS4), 30 (LATEOS5) and 50 g (LATEOS6) are chosen as the core materials and tetraethyl orthosilicate (TEOS) as the precursor solution for the formation of silicon dioxide (SiO2) as the shell materials. pH of the precursor solution is fixed at 2.5 prior to mix in oil/water emulsion.

2. Materials and Method

LA was used as the PCM. TEOS was used as the precursor solution and encapsulation material. Sodium lauryl sulphate (SLS) was used as the surfactant and hydrochloric acid (HCl) as the activator. Detailed synthesis procedure of the microencapsulated LA was depicted in Figure 1.

3. Results and Discussion

Figure 2 shows the FT-IR and XRD analysis for the microencapsulated LA with SiO2 shell at various core-shell ratio. FT-IR analysis of microencapsulated LA as shown in Figure 2 (i) exhibits a high and broad peak at 1100 cm-1 attributed to the anti-symmetrical stretching vibration of Si-O-Si band which confirmed the presence of SiO2. As the LA amount is increased, the intensity of 1100 cm-1 is decreased attributed to the thinning of SiO2 shell. The

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XRD result (Figure 2ii) shows the presence of SiO2 (amorphous) peaks (broadening) around 2θ=24-30° in lower amount of LA whereas in higher amount i.e. LATEOS6, the peak become more prominent and intense. It is attributed to the lower content of SiO2 shell. Besides, there is no new peak observed concluded that there is no chemical interaction between the LA and SiO2 shell. Lower pH of precursor solution leads to the change the condensation process of the hydrolyzed TEOS.

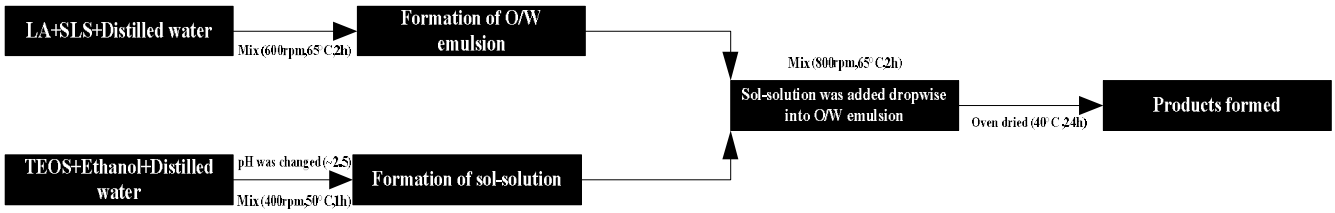
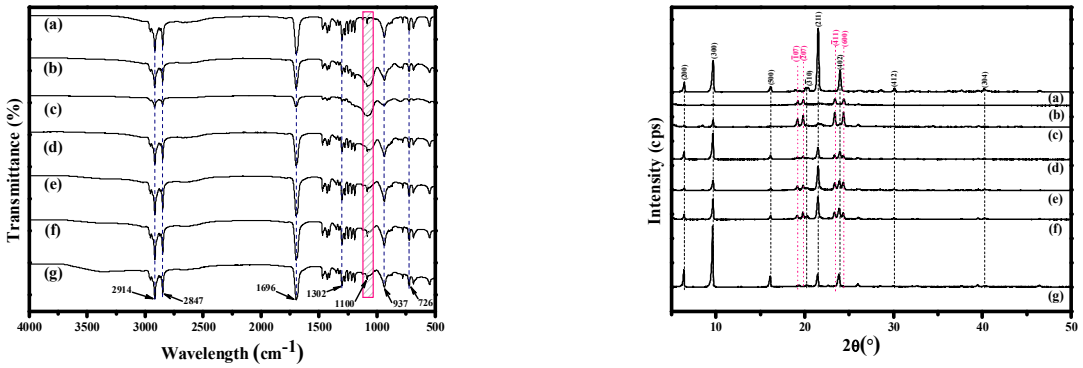


Figure 1. Preparation method



(i) (ii)

Figure 2. Result of the (i) FT-IR spectra and (ii) XRD analysis of (a) bulk LA, (b) LATEOS1, (c) LATEOS2, (d) LATEOS3, (e) LATEOS4, (f) LATEOS5 and (g) LATEOS6

4. Conclusion

Microencapsulation of LA with SiO2 shell was successfully achieved by sol-gel route at 2.5 pH where FT-IR and XRD results confirmed the presence of SiO2 in lower content of LA. As the LA amount is increased, thinning and well encapsulated LA was found. Lower pH of precursor solution leads to form well behaved microencapsulated PCM attributed to the condensation process of the hydrolyzed TEOS.

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참 고 문 헌

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