

Research Title: Development of smart textiles by immobilization of nanoencapsulated phase change materials

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ABSTRACT

Poly(diallyldimethylammonium chloride) (PDDA) polyelectrolyte encapsulated n-octadecane nanocapsules (PDDA-en-Oc) were facilely prepared and immobilized on cotton fabrics in order to generate thermo-regulating property. Firstly, an emulsion of n-octadecane and sodium dodecyl sulfate (Oc-SDS) was prepared by high intensity sonication and then mixed with the PDDA to create the PDDA-en-Oc nanocapsules, in which they successfully produced the nanocapsules with globular core-shell structure. The PDDA-en-Oc nanocapsules possessed the latent heat value in the range of 99–152 J/g with the average particle size in the range of 101–256 nm. The average particle size of PDDA-en-Oc increased with increasing of PDDA concentration from 1 to 14 mM due to the formation of different PDDA conformation and shell thickness. In addition, the increase of PDDA concentration could improve the efficiency of n-octadecane encapsulation, bringing about the increase PDDA-en-Oc nanocapsules quantity. The higher amount of encapsulated nanocapsules, the higher latent heat quantity was obtained during the phase transition of n-octadecane. The highest encapsulation efficiency was obtained at about 65.99 % when the 10 mM PDDA was used in the encapsulation process, in which it possessed the highest latent heat of about 151.97 J/g.

The as-prepared PDDA-en-Oc nanocapsules were successfully immobilized on the cationized cotton fabrics by stepwise coating with the PSS binder and PDDA-en-Oc nanocapsules. The concentration of PSS binder was varied in the range of 1–50 mM. The higher PSS concentration, the higher quantity of PDDA-en-Oc nanocapsules was immobilized on the cotton fabrics. In addition, the increase of quantity of PDDA-en-Oc nanocapsules immobilized on the cotton fabric could be obtained by stepwise soaking the cotton samples in the system of PSS binder/PDDA-en-Oc nanocapsules.

The PDDA-en-Oc immobilized cotton fabrics exhibited the thermo-regulating property, while preserved the breathability of starting cotton fabric. The prolonged duration of thermo-regulating action was obtained when increasing the quantity of PDDA-en-Oc immobilized on the cotton fabric. The cotton sample immobilized with 5 cycles of PSS and PDDA-en-Oc nanocapsules exhibited the highest thermo-regulating action for longer than 10 min when the surrounding temperature was about 50 °C.

Keywords : Phase change material, Polyelectrolyte, Nanoencapsulation, Smart textiles