SEMINAR סמינר

Encapsulation of Hydrated Salt Phase Change Materials within Polymer Monoliths through Emulsion-templating

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Phase change materials (PCMs) store and release thermal energy through their relatively high latent heat associated with melting and crystallization. Salt hydrates PCMs have several advantages over organic PCMs such as paraffins and over fatty acids: a relatively high latent heat per volume, high thermal conductivity, non-flammability, and the availability of a wide range of transition temperatures. Since salt hydrates tend to melt incongruently, resulting in irreversible melt-freeze processes, and exhibit significant supercooling, their utilization in energy storage applications has been limited. The objective of this research was to develop an innovative method of encapsulating an inorganic salt hydrate PCM within polymer monoliths, templating within molten-salt-in-oil high internal phase emulsions (HIPEs). This work focused on calcium chloride hexahydrate ($CaCl_2{\cdot}6H_2O$, CC HH), with a melting point of 30 ˚C and a latent heat of fusion of 176 J/g, that was encapsulated within an elastomeric polyacrylate based on 2-ethylexyl acrylate (EHA). The effects of HIPE stabilization, locus of polymer initiation, nucleation, crosslinking strategy, and polymerization procedures were investigated. The emulsion-templated structures were characterized using scanning electron microscopy and the thermal properties were characterized using differential scanning calorimetry. Based on the results of thermal cycling tests, the most promising encapsulation system exhibited a CC HH content of 79% dispersed within droplets of 100 to 300 µm, with melting and crystallization heats of ~120 J/gsample (~160 J/gCC HH). The addition of 3 wt % $SCl_2{\cdot}6H_2O$ as a nucleating agent reduced the extent of supercooling to 14 °C, in contrast to 43 °C for pure CC HH. The resulting average melting and crystallization temperatures were 34 °C and 20 °C, respectively. Unfortunately, the relatively interconnected droplet structure had a negative effect on the long-term thermal stability of the encapsulated CC HH, with irreversible phase separation and $CaCl_2{\cdot}4H_2O$ formation producing a 40% reduction in latent heat.

Advisor: Prof. Michael Silverstein

ההרצאה תתקיים ביום ראשון, ה-16 בדצמבר 2018 בשעה 14:30
באודיטוריום ע"ש דיוויד וואנג ,קומה 3, בניין דליה מידן

The lecture will take place on Sunday, December 16th 2018 at 14:30
David Wang Auditorium, 3rd floor Dalia Maydan Bldg.

כיבוד קל יוגש לאחר הסמינר