Bulk Nanoencapsulation of Phase Change Materials (PCMs) via Spontaneous Spreading of a UV-curable Prepolymer

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Phase change materials (PCMs) have recently gained significant attention for effective latent heat thermal energy storage. So far, diverse methods for encapsulation of PCMs have been introduced, including interfacial polymerization or sol-gel reaction, which were sometimes achieved via microfluidic droplet generation. Herein, we demonstrate a facile way of producing sub-micron PCM nanocapsules in bulk, composed of n-docosane ($C_{22}H_{46}$; core) and crosslinked polyethylene glycol (PEG; shell). The encapsulation is achieved through spontaneous spreading of liquid PEG diacrylate (phase 1) on melted n-docosane nanodroplets (phase 2) dispersed in bulk aqueous media (phase 3), which is thermodynamically driven by the relation between the surface energies of the phase 1, 2, and 3. The as-produced PCM nanocapsules displayed high durability in repeated heating-cooling cycles, and showed promising thermal performances.