FACILE SYNTHESIS OF SELF-HEALING MICROCAPSULES

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In nature biological materials self-heal and adapt repeatedly to stresses caused by the environment. So far, major efforts have been made to create engineered microcapsules that can, upon rupturing, release a healing agent. To mimic the dynamic biological function, we create functional microcapsules that release self-healing agents, but may also themselves be healed, allowing for multiple release events. Currently there are many limitations in synthesizing microcapsules with self-healing hydrogel shells. We address these challenges with a facile strategy for synthesizing monodisperse hydrogel microcapsules by the deprotection and aqueous solubilization of an initially water-insoluble polymer shell. We use a microfluidic approach to produce w/o/w emulsions as a template for microcapsules [1], where the monomer is in the oil phase. Using such a technique one can prepare poly(acrylic acid) shell microcapsules by the deprotection of a poly(tert-butyl acrylate) shell microcapsule through hydrolysis [2]. Hydrophobic comonomers and water insoluble interpenetrating polymers may be included with the tert-butyl acrylate monomer in order to form microcapsules with self-healing shell materials such as semi-interpenetrating hydrogels or hydrophobic association hydrogels [3,4]. To stabilize self-healing microcapsules we used particle armoring as self-healing hydrogels posses sticky surfaces and tend to aggregate [5]. With this work we demonstrate an easy approach to produce microcapsules with self-healing shells. These capsules will open up the possibility of repeated release from microcapsules, taking a step closer to reproducing self-healing processes seen in nature.

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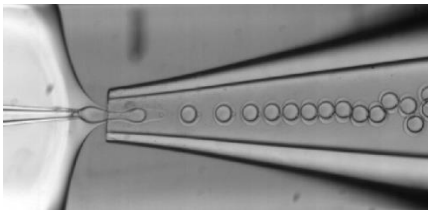

Figure 1. Synthesis of poly(tert-butyl acrylate) microcapsules using a combination of alumina nanoparticles and surfactant as stabilizers.

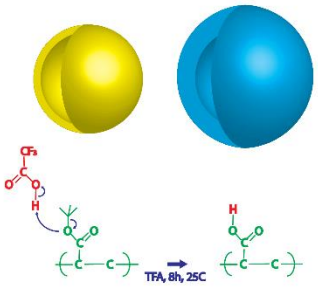

Figure 2. Hydrolysis of poly(tert-butyl acrylate) microcapsule to form poly(acrylic acid) hydrogel microcapsule.

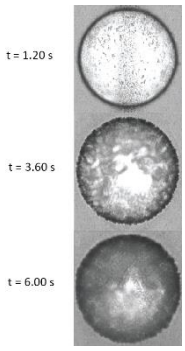

Figure 3. Oil droplets in water, stabilized by alumina nanoparticles at increasing residence time in a microfluidic channel.