Microfluidic Production of Hydrogel Microcapsules with a Thin Oil Layer for Stimuli-responsive Cargo Release

최창형†
대구한의대학교
(cchoi@dhu.ac.kr†)

We present a hydrogel microcapsule with an intermediate thin oil layer to achieve smart release of a broad range of hydrophilic cargoes triggered via diverse stimuli. A microfluidic method is used to produce triple emulsion droplets (W/O/W/O) with a thin oil layer that separates the innermost aqueous phase from the prepolymer phase, which transforms into a hydrogel shell via UV-induced free radical polymerization. The intermediate oil layer within the hydrogel microcapsule acts as a diffusion barrier, enabling encapsulation of various small cargoes within a porous hydrogel shell until a stimulus is applied to destabilize the oil layer. We show that diverse stimuli including chemical dissolution, mechanical stress, and osmotic pressure can be applied to release the encapsulated cargo on-demand. In addition, osmotic pressure and the hydrogel shell thickness can be independently varied to control the onset time of release as well as the release pattern of multiple cargoes encapsulated hydrogel microcapsule; the release can be either simultaneous or selective.