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Controlled release from stimuli-sensitive microgel capsules[1] HASSAN MASOUD, ALEXANDER ALEXEEV, George W. Woodruff School of Mechanical Engineering, Georgia Institute of Technology — We introduce a mesoscale computational model for responsive gels, i.e. chemically cross-linked polymer networks immersed in Newtonian fluids, and use it to probe the release of nanoparticles from hollow microgel capsules that swell and deswell in response to external stimuli. Our model explicitly describes the transport of nanoparticles in swelling/deswelling polymer networks with complex geometries and associated fluid flows. Our simulations reveal that responsive microcapsules can be effectively utilized for steady and pulsatile release of encapsulated solutes. Steady, diffusive release of nanoparticle takes place from swollen gel capsules, whereas capsule deswelling cause burst-like discharge of solutes driven by a flow from the shrinking capsule interior. We demonstrate that this hydrodynamic release can be regulated by introducing rigid microscopic rods inside the capsule. Our calculations indicate that the rods stretch the deswelling membrane and promote the formation of large pores in the shell, which allow massive flow-driven release of nanoparticles. Thus, our findings unveil a new approach for regulating the release from stimulus responsive micro-carriers that will be especially useful for designing new drug delivery systems.

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