A novel release mechanism from responsive microgel capsules

HASSAN MASOUD, ALEXANDER ALEXEEV, George W. Woodruff School of
Mechanical Engineering, Georgia Institute of Technology — We use a mesoscale
computational model for responsive gels to study the release of nanoparticles from
hollow microcapsules. Our model explicitly describes the transport of nanoparticles
in swelling/deswelling polymer networks with complex geometries and associated
fluid flows. Our simulations show that capsule swelling results in a steady release of
encapsulated nanoparticle, which is set by the ability of particles to diffuse through
the capsule network. For deswelling capsules, we show that a fluid flow induced
by capsule shrinking leads to rapid nanoparticle release. This release, however,
is limited due to decreasing mesh size of the deswelling shell. We show that by
introducing solid microrods inside deswelling capsules, we can control the rapid
release. Our calculations reveal 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 reveal a new approach for regulating
the release from stimulus responsive micro-carriers that may be useful for designing
new drug delivery systems.

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Hassan Masoud
Georgia Institute of Technology

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