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Swelling Kinetics of a Microgel Shell JOSHUA WAHRMUND, University of North Texas, JIN-WOONG KIM, LIANG-YIN CHU, Harvard University, CHANJIE WANG, Haynes and Boone, LLP, YONG LI, Kimberly-Clark Corporation, ALBERTO FERNANDEZ-NIEVES, Harvard University, DAVID A. WEITZ, Harveard University, ARKADII KROKHIN, ZHIBING HU, University of North Texas — Tanaka's approach to swelling kinetics of a solid gel sphere is extended to a spherical microgel shell. The boundary condition at the inner surface is obtained from the minimization of shear elastic energy. Temporal evolution of a shell is represented in a form of expansion over eigenfunctions of the corresponding diffusion equation. The swelling of Tanaka's solid spherical gel is recovered as a special case of our general solution if the inner radius approaches zero. To test our theoretical model, we prepared monodisperse poly-N-isopropylacrylamide (PNIPAM) hydrogel shells using a microfluidic device. The temporal dependence of the inner and outer radii of the shell was measured and the data was fitted to our theoretical model. As a result, we obtained the collective diffusion constants for shrinking and for swelling processes. The obtained values for microgel shells are in excellent agreement with the previous results obtained for sub-millimeter PNIPAM solid spheres in the same temperature interval. Our model shows that the characteristic swelling time of a gel shell should be proportional to the square of its outer radius—just as with Tanaka's model.

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