Encapsulating active cytoskeletal networks in cell-sized liposomes

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Abstract

In a living cell, the cell membrane defines the cell boundary and interacts intimately with the cytoskeleton in numerous cellular functions, including cell motility and division. Cell shape changes are for a large part mediated by the contractile actomyosin network forming the cortex underneath the cell membrane. To uncover molecular mechanisms of cell shape control based on actin-membrane interactions, we have developed a novel biomimetic model system: a cell-sized liposome encapsulating an actively contracting actin-myosin network. Our fabrication method is inspired by a recent report of liposome preparation by swelling of lipid layers in agarose hydrogel films[1]. We extensively characterize important liposomal properties, finding diameters between 10 and 20 μm, unilamellarity, and excellent and uniform encapsulation efficiency. We further demonstrate chemical control of actin network anchoring to the membrane. To quantitatively study the dynamics of these actin-membrane composites, we extract membrane fluctuation spectra from video-tracked membrane contours. We will extend classical Helfrich fluctuation models of bare membranes to include mechanically coupled viscoelastic network phases, and compare derived fluctuation spectra with our measurements.

[1] Horger, K. S.; Estes, D. J.; Capone, R.; Mayer, M., Films of agarose enable rapid formation of giant liposomes in solutions of physiologic ionic strength. *J Am Chem Soc* **2009,** *131* (5), 1810-9.