Designer vesicles from synthetic surfactants - block-co-polymers and recombinant proteins.

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Vesicles are biomimetic capsules with large payloads for drug delivery and imaging. Vesicles are self-assembled from surfactants of appropriate physical properties, such as phospholipids. We have developed vesicles from novel surfactants, including block-co-polymers and protein surfactants, in which the materials properties, adhesiveness and responsiveness can be widely tuned. Vesicles assembled from polymers, also known as polymersomes, can be engineered with tunable elasticity. By incorporating hydrophobic optical emitters within the membrane of polymersomes, we have developed vesicles which can disassemble upon illumination and be used as stress sensors. Recently, we have discovered a recombinant surfactant protein that can be expressed in bacteria, purified, and widely engineered through properties of molecular biology. We show that this protein can assemble into vesicles, but engineered variants can make unique materials, such as worm-like micelles and sheets. In summary, we have a spectrum of surfactant molecules that can assemble into nano-vesicles and be used for a wide variety of technological applications.