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Microfluidic Fabrication of Bio-compatible Vesicles by Self-assembly in Double Emulsions HO CHEUNG SHUM, Harvard School of Engineering and Applied Sciences, Harvard University, JINWOONG KIM, Amore Pacific Co. R&D Center, DAEYEON LEE, Harvard School of Engineering and Applied Sciences, Harvard University, DAVID WEITZ, Harvard School of Engineering and Applied Sciences, and Department of Physics, Harvard University — Vesicles are compartments surrounded by bilayered membranes of amphiphilic molecules such as diblock copolymers and phospholipids. To minimize the exposure of their hydrophobic part to water, amphiphilic molecules self-assemble into aggregates of different structures. When the hydrophobic to hydrophilic ratio is close to unity, amphiphiles self assemble into bilayers, which tend to fold themselves into vesicles. These vesicles are useful for encapsulating and transporting actives such as drugs, flavor, and fragrance. To solve the problems of low encapsulation efficiency and large vesicle size distributions afforded by traditional techniques to create vesicles, we engineer a novel route to generate vesicles using monodisperse double emulsions prepared in microfluidics as templates. The double emulsion-to-vesicle transition exhibits different behaviors depending on the properties of the amphiphilic molecules such as the hydrophobic-to-hydrophilic ratio. Using this technique, we have fabricated both bio-compatible diblock copolymer vesicles, also known as polymersomes, and also lipid vesicles with high encapsulation efficiency.

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