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Microfluidic Fabrication of Functional Capsules with ultra-thin membranes[1] SHIN-HYUN KIM, ALIREZA ABBASPOURRAD, DAVID WEITZ, Harvard University — We have developed a new emulsification technique to produce monodisperse double-emulsion drops with an ultra-thin middle layer through a one-step emulsification. A biphasic flow, consisting of sheath of one fluid flowing along the capillary wall and surrounding a second fluid flowing through center of the capillary, is created in a form of either a jet or drops, which is emulsified into double-emulsion drops with ultra-thin middle layer. The ultra-thin middle phases provide stability to the double-emulsion drops by putting the fluid in the middle phase in the lubrication regime. We have employed such stable double-emulsion drops to make functional microcapsules using evaporation-induced consolidation. Simplest form is microcapsules with homogenous membrane. Using biodegradable polymers such as PLA or PLGA as a membrane material, we can achieve a long-term release of various bioactives from the capsules as the membrane degrades by hydrolysis. Heterogeneous membrane can also be prepared by using polymer blends. For example, a polymer blend of PMMA and PLA with small interaction parameter makes heterogeneous structure at nanoscale, while a polymer blend of PS and PLA with large interaction parameter makes their phase separation at one micrometer scale.

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