Interface assembly of microcapsules via liquid-liquid droplets templates

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1. Introduction

In the advanced drug delivery and release systems, isolation and protection of the core ingredients from the complicatedly and brutally external environment is often an essential step.[1] Microcapsules recently are accepted as versatile tools to achieve such objectives, have boomed greatly. However, fabrication and mechanical properties tuning of microcapsules through a cost-efficient route are still two challenging aspects. Here, we propose a facile method of assembling capsules shell by taking advantage of two oppositely charged ingredients naturally, via the liquid-liquid droplets templates produced by microfluidic technique. [2] The capsules shells are formed by adding negatively charged surfactant, phosphatidic acid (PFacidYN) around liquid droplets templates filled with positively charged polysaccharid (chitosan). Controlling of the shell complexation time and concentrations of PFacidYN and chitosan allows us to tune the shell properties in a large range which could satisfy various using purposes. We utilize a millimetric cross-slot flow cell to characterize the shell properties,[3] including interfacial rheology and shell instability.

2. Results

A T-junction microfluidic chip is used to make the liquid-liquid droplets templates, as shown in figure1(a). Thanks to the flow rates of two immiscible phases well controlled in microfluidic systems, the size distribution is within 5%, in figure1(b). Surface shear elastic modulus of interface is measured based on the small deformation theory, in figure1(c). Since the thickness of capsule shell, h≪R, where R is radius of capsule, shell instability happens when the total energy is sufficiently large that induces the thin shell bending out of the surface. And the critical buckling state has been studied experimentally.

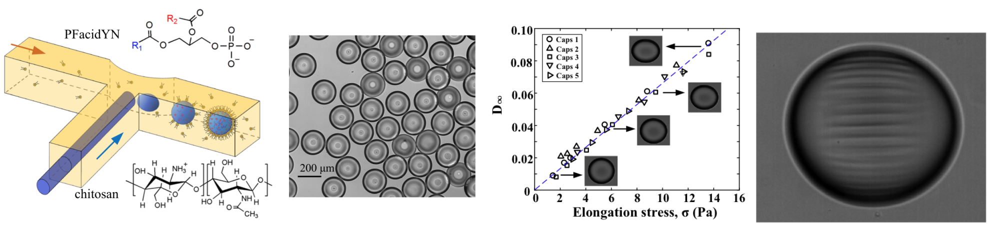

Figure 1: From left to right: (a)liquid-liquid droplets generated in T-junction chip; (b) monodisperse capsules on substrate; (c) Capsules steady-state deformation with elongation stress; (d) shell instability

References

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