Noncovalent interactions in microfluidic devices

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Noncovalent interactions play an important role in creation of microparticles in microfluidic devices. The examples of such microparticles fabricated in microfluidic devices using monodisperse single and multiple emulsion drops as templates are shown in Fig. 1. Colloidosomes are hollow shells composed of colloidal particles formed by self assembly at the interface of emulsion drops. Giant lipid vesicles (liposomes) are molecular structures greater than 1 μm in diameter formed by self assembly of phospholipids, such as phosphatidyl choline (PC) into concentric bilayers. Asymmetric liposomes have different lipid molecules in the inner and outer layer, e.g. 1-palmitoyl-2-oleoyl-phosphatidylcholine (POPC) and 1-palmitoyl-2-oleoyl-phosphatidyl-L-serine (POPS). Polymerosomes are vesicles formed by self assembly of diblock copolymers.

![Fig. 1. Examples of microparticles created in microfluidic devices by particle or molecular self assembly.](image)

These self-assembled vesicles can be fabricated in flow focusing microfluidic devices shown in Fig. 2. For example, polymerosomes can be produced using core/shell drops in which the shell fluid is a volatile mixture of organic solvent that contains dissolved diblock copolymers and both the inner and outer fluid is an aqueous solution (Fig. 3). After the solvent is evaporated, diblock copolymers self assemble into bilayer membranes. The hydrophobic parts tend to minimise the contact with water and attract each other, while the hydrophilic parts prefer contact with water and repel each other, forming the outer shells of membranes.

![Fig. 2. Glass microcapillary devices for production of uniform simple and core-shell emulsion drops [1].](image)

![Fig. 3. Core-shell drops with a core diameter of 62 μm and a shell thickness of 8 μm produced by G.T. Vladisavljević using the device shown in Fig. 2b.](image)

References