PENN CENTER FOR INNOVATION

One-step generation of stimuli-responsive, multifunctional polyelectrolyte microcapsules

Nanoscale interfacial complexation in emulsions and spontaneous droplet hatching for microcapsules

Inventor

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Problem

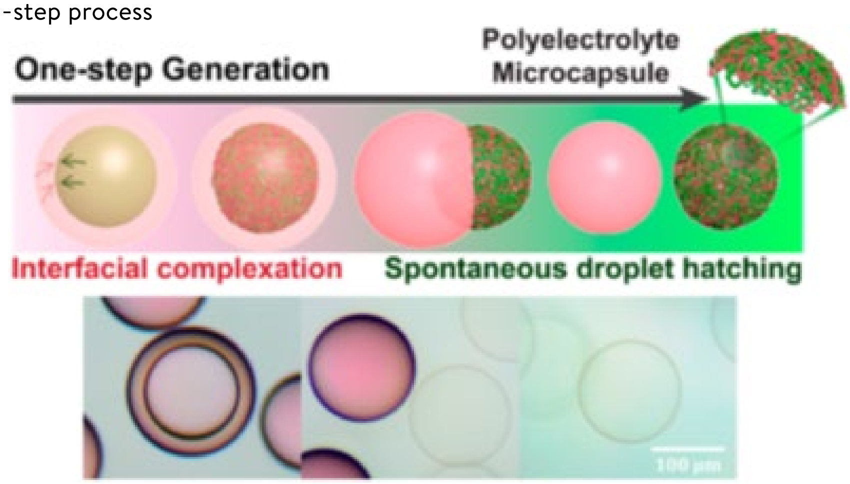
Polyelectrolyte microcapsules can be prepared by a layer-by-layer assembly method to form nanoengineered shells that are sensitive to external stimuli and enable the encapsulation, protection, and release of active agents. Conventional synthesis approaches suffer from low efficiency and do not accommodate incorporating hydrophilic and hydrophobic materials simultaneously.

Solution

Researchers in the Lee lab have developed a nanoscale interfacial complexation in emulsion (NICE) method that involves the complexation of two polymers that self-assemble to form an insoluble layer at an oil-water interface. The method uses a microfluidic device that contains a water-oil-water interface. The polymer complex is formed at the outermost water-oil interface, and the material to be encapsulated is introduced at the innermost water layer. Oppositely charged polymers are sequentially deposited onto a sacrificial solid core to form polyelectrolyte complex-based coatings on the solid particle. The core particle is removed via dissolution to form a hollow microcapsule, with target encapsulants introduced through the microcapsule shell by tuning the permeability to achieve microencapsulation.

Advantages

- Ability to encapsulate range of materials with different chemical properties
- Higher encapsulation efficiency than layer-by-layer assembly methods
- Responsive to changes in chemical gradients, ionic strength, or pH
- Functionalize with nanomaterials for response to magnetic field or light
- Highly monodisperse polymer shells
- One-step process



STATE OF DEVELOPMENT

Proof-of-principle production of polyelectrolyte nanocapsules; device fabrication

INTELLECTUAL PROPERTY

UP application

REFERENCE MEDIA

Kim M. et al. ACS Macro Letters, 2016, 5, p. 487-492.
Kim M. et al. ACS Nano, 2015, 9, p. 8269.

DESIRED PARTNERSHIP

License
Co-development

APPLICATIONS

- Encapsulate materials for controlled release
- Synthesize highly monodisperse shells with variety of chemistries
- Drug delivery
- Cell mimicry
- Food industry

LEARN MORE

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