Lipid domains for the production of patchy emulsions

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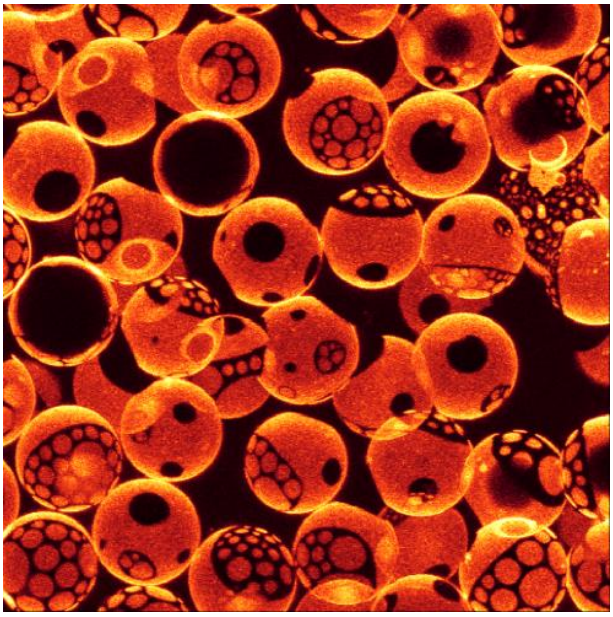
We develop bioinspired emulsions that mimic the minimal properties of adhesive cells in tissues. This versatile system is also adaptable for the programmed self-assembly of the droplets. Indeed, the droplets are stabilized with phospholipids and can be functionalized with adhesivemolecules for specific droplet-droplet interactions. In particular,we functionalize the droplets with complementaryDNA strands, leading to specific, reversible and tunable interactions between the droplets.

The valence of the dropletsis controlled through the density of binders on the surface: for instance, the number of adhesion patches per droplet can be fixed to 2, leading to the self-assembly of droplet chains. However the orientation of the droplets in those structures is not controlled and patchy particlesare needed to fix the geometry of the final assemblies. We here present a method for patchy particle production that relies on the spontaneous decomposition of immiscible lipid mixtures into domains on the droplets surface.Those mixtures create diverse surface morphologies, such as spots, stripes and hemispheres, reminiscent of those observed in the membranes of liposomes or cell membranes.The ternary phase diagram shows that these structures are present even in binary mixtures and can be stable over weeks in the emulsions, making this system a good candidate for the straight forward synthesis of patchy particles for self-assembly. We study the origin of this stability and tune the emulsion parameters in order to control the number and size of the patches on each droplet. This emulsion system opens the route to directed self-assembly of more complex structures through distinct DNA bonds with varying strengths and controlled valence and flexibility.



Patchy emulsion droplets. Droplet diameter = 20μm