FUNCTIONAL MATERIALS VIA INTERFACIAL ASSEMBLY: STRIPS BIJELS, NICE, & AWESOME STRUCTURES

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Fluid interfaces are versatile sites for materials assembly; molecules and particles alike adsorb at interfaces to produce novel functional structures via processes suitable for scalable production. Here, three types of structures of interest to this community are described. First, hierarchical bijel structures are discussed, formed by *S*olvent *I*nduced *P*hase *S*eparation (STRIPS). Bijels, *bi*continuous *i*nterfacially *j*ammed *e*mulsion ge*l*s, feature bicontinuous networks with oil-continuous and water-continuous channels. In STRIPS, asymmetric bijel structures are formed via phase separation of a ternary mixture of oil, water and co-solvent. Phase separation, induced by solvent extraction, is arrested to form a bicontinuous structure by the interfacial attachment and jamming of nanoparticles. These structures feature dense populations of nanoparticles on their interfaces that provide additional functionality, and are ideal for loading with hydrophilic or hydrophobic molecules for delivery. Furthermore STRIPS bijels can be crosslinked to a polymeric structure with high continuous tortuous channels suitable for diverse applications. Second, polyelectrolyte (PE) capsules formed by *n*anoscale *i*nterfacial *c*omplexation in *e*mulsions (NICE) are described. Using microfluidics, single emulsions or water-oil-water emulsions are formed. PEs in the oil and aqueous phases complex at the interface to form a membrane. Important similarities and differences from related structures formed by layer-by-layer (LbL) assembly are discussed. In particular, interfacial complexation process is a one step process that is far less laborious than its LbL counterpart. Finally, capsule formation is explored via complexation at the fluid interface formed between droplets in an external phase from an aqueous two phase system. This avoids potentially deleterious oil phases. We study complexation of pairs of PEs, one in the drop phase, the other in the external phase. By balancing the fluxes, capsules are formed. Extensions to complex charged nanoparticles (NPs) with an oppositely charged PE lead to an unexpected structure: multiple emulsions form, with internal droplets that are free of adsorbed materials encased within an external PE/NP shell. These All Water Emulsion Bodies, or AWEsomes, are discussed as means to encapsulate entities ranging from molecules to microbes.

References

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