Colloidal Superstructure of DNA-Coated Polymer Particles and Clusters

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DNA-coated colloidal particles may form three-dimensional structures as programmed, which may be further extended to multi-component hybrid materials with multi-functionality. We have developed a method to create high-density DNA coatings on colloidal particles that can be used for DNA-mediated self-assembly of single- and multiple-component colloidal crystals. First, we modify an amphiphilic diblock copolymer consisting of a hydrophobic polystyrene (PS) block and a hydrophilic poly(ethylene oxide) (PEO) block with azide functional groups at the end. Then, we introduce the diblock copolymers into an aqueous suspension of colloidal polymer particles swollen with a solvent. The hydrophobic PS anchoring block is incorporated into the swollen polymer spheres and physically trapped when the solvent is removed, resulting in a dense PEO polymer brush with azide functional end groups. Finally, single-stranded DNA strands with sticky ends are attached to the azide groups using strain-promoted azide–alkyne cycloaddition. This procedure results in a high areal coverage more than 225,000 DNA strands on 1-μm-diameter particles. The ssDNA-coated particles with sticky ends can readily form either face-centered-cubic (fcc) or cesium chloride (CsCl) crystal structures when annealed just below the melting temperature of the DNA-coated particles. Furthermore, by assembling DNA-coated colloidal clusters together spheres, $MgCu_2$ structures are formed which are interpenetrating structures of diamond and pyrochlore lattices. Finally, I will discuss how to reduce DNA-coated nanoparticles down to around 100 nm keeping high density of DNA for further applications.