Biomimetics with DNA origami

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DNA nanotechnology has recently provided a wealth of techniques to fold DNA into well-defined complex two- and three-dimensional structures in a programmable manner. For inorganic materials such a synthesis scheme with freely programmable shapes has so far been missing. Biological systems, however, developed a couple of mechanisms how to assemble inorganic matter with complex shapes, e.g. by using correspondingly formed biomolecular structures as templates. Here we show that rigid three-dimensional DNA origami nanostructures can be used to fabricate gold nanoparticles with predesigned shape. In particular, the DNA structures are used as molds to dictate the final shape of the metal particles that form by a seeded-growth procedure. The individual molds can be furthermore used as bricks to build extended and more complex mold structures. These support then the formation of extended metal structures, such as µm-long gold nanowires with much higher uniformity than obtained in previous DNA metallization procedures.
In addition to shaping gold nanostructures, we show how 2D higher order assemblies of rigid origami structures can be used to deform lipid membranes. The produced origami networks mimic hereby the functionality of a particular class of membrane proteins.