Tools and materials assembled from DNA

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DNA has proven to be an excellent choice of molecule for programmable self-assembly. In recent years, DNA self-assembly has surpassed its early stages and today is routinely used for constructing functional two- and three-dimensional nanomachines and materials [1,2].
By defining attachment sites for active components on DNA structures, our group has realised complex and nanometer-precise assemblies of biomolecules, organic fluorophores and inorganic nanoparticles [3]. We employed these devices as autonomous force spectrometers [4] and to create new plasmonic effects. These effects, in turn, enable the selective and sensitive detection of proteins and virus-derived RNA molecules [5].
The initial thrust catalyzing the rapid development of DNA nanotechnology has been to arrange periodic DNA frameworks to host guest molecules for crystal structure analysis. Despite enormous efforts and fundamental progress, placing guest molecules in designed DNA crystals remains a challenging goal. By adopting design principles of Ned Seeman and Chengde Mao [6], we are now able to crystallise DNA origami structures that grow into three dimensional, micrometer-scale assemblies [7]. Silicification of these crystals leads to designer nanomaterials that withstand drying without structural deformation [8].
Our results demonstrate the assembly power of DNA and our ability to fabricate functional devices and 3D materials that are designed on the molecular level while reaching macroscopic dimensions.

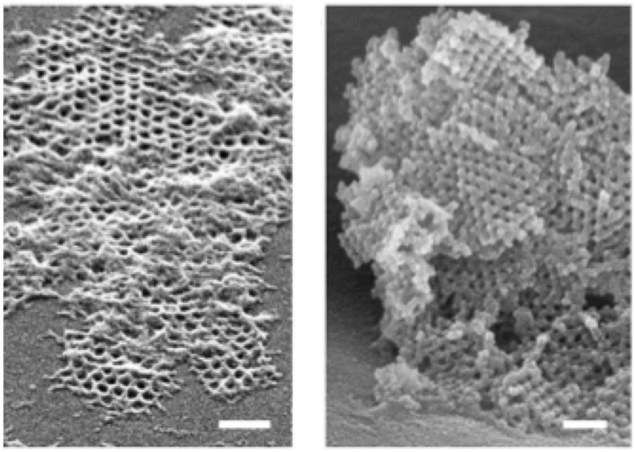

Figure 1: Silica growth on DNA origami crystals. Left: 60° tilted view of bare DNA origami crystals. The crystals flatten upon adsorption to the grids. Right: 60° tilted view of silica coated DNA origami crystals. The 3D structure is preserved. Scale bars are 200 nm..

References

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