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DNA origami as a nanoscale building material

Title of the doctoral thesis	DNA Origami as a Tool for Assembling Functional Biohybrid Nanomaterials
Content of the doctoral thesis	DNA is commonly known as the carrier of genetic information, but it is also an excellent nanoscale building material. The Watson-Crick base-pairing is highly specific and join single-stranded DNA molecules in a pre-programmed manner, which in DNA nanotechnology is used to form DNA-based nanostructures with desired shapes. A commonly used method to construct DNA nanostructures is the DNA origami technique. It allows us to fold a long single-stranded DNA molecule, the 'scaffold' strand, into an arbitrary and well-defined nanoscale object by hundreds of shorter DNA molecules, 'staple strands' that bind to multiple parts of the scaffold and fold it into the desired shape. The DNA origami structures can also easily be modified with e.g., metal nanoparticles and stimuli-responsive elements, and could therefore be used for applications in for example nanomedicine and nanofabrication. With current nanofabrication techniques, stimuli-responsive and highly ordered nanomaterials are challenging to construct. DNA origami are highly negatively charged due to the phosphates in the DNA backbone and could therefore serve as building blocks in nanomaterials assembled by electrostatic interactions. By co-assembling DNA origami with positively charged lipids and gold nanoparticles, methods for constructing ordered lipid assemblies and gold nanoparticle lattices were developed in this doctoral thesis. Hierarchical DNA origami lattices can also be constructed by linking several DNA origami units together, but these have so far been mainly static. In this work, a DNA origami-based lattice that switches between an open and a closed state based on pH of the surrounding solution was constructed by incorporating pH-sensitive elements into the lattice-forming DNA origami unit. The doctoral thesis advances the use of DNA origami in nanofabrication and demonstrates that DNA origami could function as a versatile building block in sophisticated nanomaterials.
Field of the doctoral thesis	Chemical Engineering
Doctoral candidate and contact information	M.Sc. (Tech.) Sofia Julin sofia.julin@aalto.fi
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Remote defence	https://aalto.zoom.us/j/64266358169
Place of public defence	Aalto University Lecture Hall M1, Otakaari 1, Espoo
Opponent	Assistant Professor Maartje Bastings, EPFL, Switzerland
Custos	Professor Mauri Kostiainen, Aalto University School of Chemical Engineering
Link to electronic thesis	https://aaltodoc.aalto.fi/handle/123456789/51
Keywords	DNA origami, self-assembly, electrostatic interactions, functional materials, stimuli-responsive

Dissertation will be on public display at https://aaltodoc.aalto.fi/doc_public/eonly/riiputus/