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Title: DNA based Nanobiotechnology

In recent years, a number of research groups have begun developing nanofabrication methods based on DNA self-assembly. DNA is an extraordinarily versatile material for designing nano-architectural motifs, due in large part to its programmable G-C and A-T base pairing into well-defined secondary structures. These encoded structures are complemented by a sophisticated array of tools developed for DNA biotechnology: DNA can be manipulated using commercially available enzymes for site-selective DNA cleavage (restriction), ligation, labeling, transcription, replication, kination, and methylation. DNA nanotechnology is further empowered by well-established methods for purification and structural characterization and by solid-phase synthesis, so that any designer DNA strand can be constructed.

Here we present our recent experimental progress to utilize novel DNA nanostructures for self-assembly as well as for templates in the fabrication of functional nano-patterned materials. We have prototyped a new nanostructured DNA motif known as a cross structure1. This nanostructure has a 4-fold symmetry which promotes its self-assembly into tetragonal 2D lattices. Each unit cell can be considered as an individual pixel; if unique DNA labels can be assigned to each cross structure, they can be used to construct 2D arrays with individually addressable binding sites. We have also demonstrated a DNA barcode lattice2 composed of DNA tiles assembled on a long scaffold strand; the system translates information encoded on the scaffold strand into a specific and reprogrammable barcode pattern which is visible by atomic force microscopy. We have achieved gold nanoparticle linear arrays templated on DNA arrays comprised of triple crossover (TX) molecules3. We have designed and demonstrated a 2-state DNA lattice4 which display expand/contract motion switched by DNA nanoactuators. We have also developed an autonomous DNA motor executing unidirectional motion along a linear DNA track5.

References:

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