Programmable DNA Lattices: Design Synthesis & Applications

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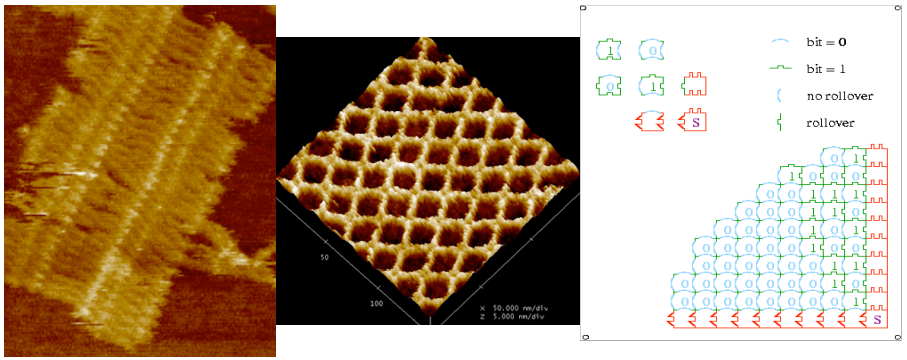
Subcontracts: NYU (Nadrian Seeman), Caltech (Erik Winfree & Niles Pierce)

Scientific Objectives: *Programmable construction of complex nanostructures of supramolecular (10-100 nm) scale:* -DNA lattices with complex 2D patterning
-periodic 3D DNA lattices.



Tiling Design for Binary Counter

New Ideas: *Molecular Self-assembly:*
-DNA strands self-assemble into *DNA tile* nanostructures.
-DNA tiles self-assemble into periodic and aperiodic lattices.

Algorithmic Self-assembly:
-DNA tiles form DNA lattices with complex patterning.
-Methodology is *programmable* by choice of DNA tiles.

Nanostructure Templating and Patterning:
-DNA lattice superstructure for other complex nanostructures.
-Other molecular nanostructures attach to specific DNA strands within DNA lattices.

Impact to US defense:
Protein structure determination via host-lattice crystals:
-Periodic 3D DNA lattices capture proteins for X-ray diffraction. *Key spin-off:* Structural characterization of antigens from pathogens.

Patterned DNA Lattice Technology:
-DNA nanostructures can serve as scaffolds for molecular sensors and actuators.
Key Spin-off: identifying pathogens (e.g., bacteria).
-DNA lattices can be used as scaffolds for positioning molecular electronics components into complex circuits.
Key Spin-off: Molecular Nanoelectronics.

Schedule:

Design of novel DNA tiles & lattices and support software

Optimization algorithms for DNA design implemented.
Patterned 2D DNA lattice: modest size (64 tiles)
Periodic 3D DNA lattices: diffracting to 2.5 Å

Characterization of error rates of self-assemblies
Patterned 2D DNA lattices: moderate size(512 tiles)
Periodic 3D DNA lattice: diffracting to 2.5 Å

Self-assembly of 4-bit demultiplexing RAM
Patterned 2D DNA lattices: thousands of tiles
Periodic 3D DNA lattices: diffracting to 2.5 Å

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