Nano4 / Nano6, 2008 – Research Project
Supervision: Laurent Duroux / Leonid Gurevich

DNA self-assembly into organized nano-structures

Many **biopolymers** have the capacity to **self-organize** to form well-defined 3D structures: think of the folding of peptides into functional proteins and, further, of the assembly of some proteins into larger multi-units complexes. Another classical example is the self-organization of DNA strands into its famous “double helix” structure.

Twenty years ago, N. Seeman (NY University, USA) demonstrated that, by careful design of DNA sequences, it was possible to obtain the arrangement of the DNA strands into simple geometric structures (tiles) of nanometer size (Fig 1). Later, he and his collaborators showed that it was possible **to create regular 2D and 3D patterns with these “DNA tiles”** (Fig 2). Since N. Seeman’s landmark insights, the concept of DNA tiling has grown into a nanotechnology of its own, where it is possible **to program DNA sequences**, in order to achieve virtually any kind of 2D or 3D nano-architectures. The concept has generated multiple applications in nanotechnology such as DNA-guided assembly of proteins (nano-arrays) or nano-electronic circuits (to cite a few).

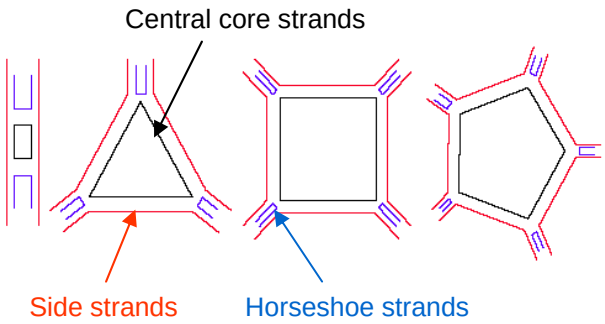

Figure 1: *Geometrical structures from 3 DNA strands hybrids*

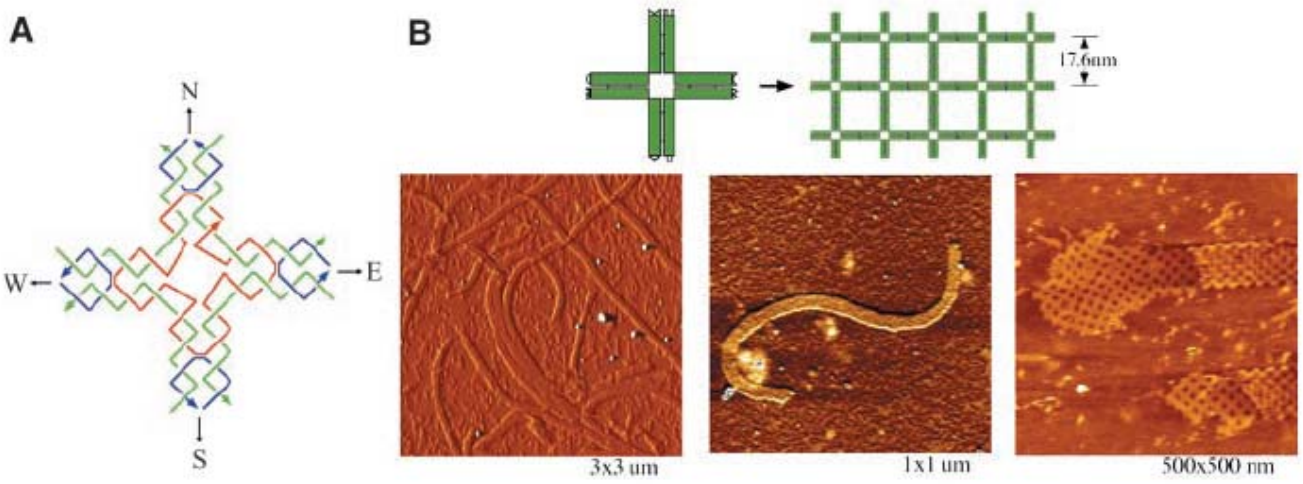

Figure 2: *DNA 2D lattices from 4x4 DNA tiles as seen by AFM* (Yan et al, 2003. Science 301:1882-84)

We propose, in this project, for a group of students to experience the design and "construction" of DNA tiles and patterns by self-assembly processes. The nano-sized constructions will be characterized by selected spectroscopic methods such as DLS, CD and ultimately visualized with AFM. It is envisaged that a number of parameters controlling the self-assembly process will be studied, like temperature, ionic strength,…

Key References:

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Junghuei Chen, Nadrian C. Seeman, "Synthesis from DNA of a molecule with the connectivity of a cube," Nature 350:631-633

E. Braun, Y. Eichen, U. Silvan, G. Ben-Yoseph, "DNA-templated assembly and electrode attachment of a conducting silver wire," Nature 391:775-778.

C.M. Niemeyer, T. Sano, C.L. Smith, C.R. Cantor, "Oligonucleotide-directed self-assembly of proteins: semisynthetic DNA – streptavidin hybrid molecules as connectors for the generation of macroscopic arrays and the construction of supramolecular bioconjugates," Nucleic Acids Res. 22:5530-5539.