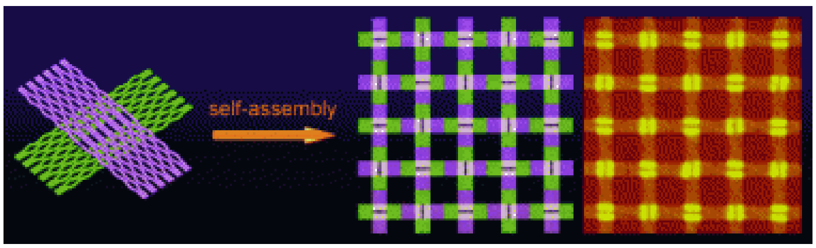
DNA weaving: Two-dimensional crystals from DNA origami tiles

November 16 2010



(PhysOrg.com) -- DNA is more than just a carrier for our genetic information; DNA is also an outstanding nanoscale building material, as researchers led by Ned Seeman discovered thirty years ago. Seeman and his colleagues at the New York University (USA) have now used cross-shaped DNA tiles to produce an amazingly large grid structure that resembles woven fabric. As the researchers report in the journal *Angewandte Chemie*, these two-dimensional crystals attain dimensions of about 2x3 micrometers.

The specific pairing of complementary bases makes DNA an ideal nanoscale building component. It is possible to incorporate particular base sequences that specifically bind to their counterparts. These are called “sticky ends”, and can be used to assemble tailored structures. Many nanostructures and nanomachines have previously been made from DNA. This technology experienced an upsurge a few years ago because of a new twist: the DNA origami technique developed by Paul Rothemund. As in origami, the Japanese art of paper folding, a long single strand of DNA is folded into a desired three-dimensional shape through short synthetic DNA oligonucleotides.

Seeman and his co-workers have also made use of this technique. They used this origami method to fold the DNA into the shapes they needed: cross-shaped tiles. The crosses consist of two mutually orthogonal overlapping strips, like two plasters stuck on top of each other to make a cross. On the four sides of the cross there are several sticky ends; the sticky ends opposite each other are identical. The researchers used two different sets of origami crosses with different sticky ends.

These ends are designed so that the crosses bind together in an alternating pattern through a self-organization process—such that the lower strip of one cross is always bound to the upper strip of its neighbor. This results in a two-dimensional structure that has a lattice-like woven appearance when viewed through an electron microscope. The alternating construction of upward and downward curved crosses is necessary to produce a planar surface. Randomly assembled crosses often lead to tubular structures.

“Our new approach could smooth the way for the industrial production of nanostructures through molecular self-organization processes,” hopes Seeman.

More information: Nadrian C. Seeman, Crystalline Two-Dimensional DNA Origami Arrays, *Angewandte Chemie International Edition*, dx.doi.org/10.1002/anie.201005911

Provided by Wiley