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DNA nanostructures make up bar-code

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Scientists at Duke University, US, have used DNA self-assembly around a "scaffold" strand of DNA to create a bar-code pattern containing digital information. The technique could have applications in making components for molecular electronics and in DNA computing.

"Ours is the first demonstration of a bottom-up method for patterning molecular-scale objects in a programmable way," John Reif of Duke University told *nanotechweb.org*. "By 'programmable' I mean that the bar-code patterns seen are determined by a 'scaffold' strand of synthetic DNA. The other strands of DNA assemble around the scaffold strand to form the 2D bar-code patterned lattice."

Reif and colleagues made the bit pattern 01101 by using a pre-assembled input DNA strand to encode the pattern information. Other DNA strands assembled themselves into the desired arrangement of DNA tiles around this scaffold strand. The scientists were able to examine the DNA pattern by atomic force microscopy: the presence of DNA hairpin loops protruding from the DNA lattice represented a bit value of 1, while the absence of loops represented a 0.

To demonstrate the technique's programmability, the scientists modified the scaffold strand and one of the strands composing each DNA tile to create a DNA lattice displaying the pattern 10010 - a direct inversion of 01101.

"We had to conceive a bottom-up method for patterning molecular structures at a scale far below what is possible by conventional top-down patterning methods, such as lithography," said Reif. "One of the technical difficulties is the choice and design of those DNA strands which are part of the DNA lattices. Computer programs are used to aid in this design process."

The technique could have applications in building scaffolding "on which molecular electronics and robotics components can be positioned with precision and specificity", as well as in DNA computing.

Now Reif and the team plan to form complex two-dimensional patterned DNA lattices. "Using these patterned DNA lattices as scaffolds, we intend then to self-assemble molecular electronic circuit components on them, with the goal of forming molecular-scale electronic circuitry," he said. "Their size would be far smaller than conventional electronic circuits."

The researchers reported their work in the *Proceedings of the National Academy of Sciences*.

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