NANO HIGHLIGHT
Programmed Assembly of Nanocomponents by DNA Scaffolding

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PROGRAMMED ASSEMBLY of nanocomponents by DNA scaffolding holds promise as an enabling technology for manufacturing future electronic circuitry based on nanoparticles, molecules, and other nanoscale devices. An interdisciplinary team has recently demonstrated an important step toward realizing this technology by demonstrating the precision alignment of nanoparticles to a high-quality DNA scaffolding.

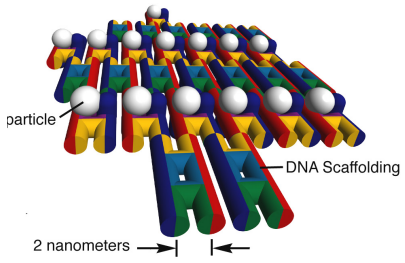

Fig. 1. Schematic diagram illustrating the programmed assembly of nanoparticles along attachment lines on a DNA scaffolding. Colored segments represent DNA strands that self-assemble into a fabric-like repetitive structure. Particles and other nanocomponents precisely attach to the scaffolding along lines by Watson-Crick base pairing.

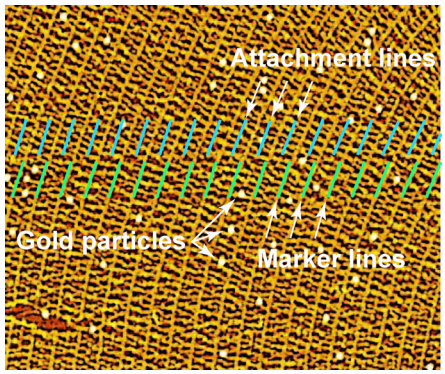

Fig. 2. Atomic force microscopy image demonstrating the assembly of gold nanoparticles along precision attachment lines on a DNA scaffolding. Marker lines have a similar DNA structure but are designed to remain particle-free. (Blue and green segments indicate line positions. Markers are 64 nanometers apart.)

DNA scaffolding is a flat structure formed by the self-assembly of about two-dozen different types of single-stranded DNA. The ATCG base sequence for each type of strand is programmed so that a mixture of strands self-assembles into molecular "tiles" (represented by 5-color cells in Fig. 1), which in turn assemble into a repetitive, two-dimensional structure called a "scaffolding". This research explores various schemes for assembling nanocomponents by chemically bonding them to the DNA scaffolding at specific attachment points.

Earlier work by members of the team reported preliminary results demonstrating the assembly of nanoparticles on small pieces of scaffolding [2]. However, the assembly of nanoparticles to large, high-quality scaffolding was not previously demonstrated. Recently, this important next step was taken. As shown by the high-resolution image in Fig. 2, gold nanoparticles have been precisely attached along chemically active attachment lines midway between chemically inactive DNA markers in a high-quality DNA scaffolding. These results suggest that the next major milestone for this technology – the precision assembly of closely spaced nanoparticles in long, nearly perfect arrays – is within reach.

References

[1] For further information about this project email **kiehl@ece.umn.edu**.
[2] S. Xiao, F. Liu, A. E. Rosen, J. F. Hainfeld, N. C. Seeman, K. Musier-Forsyth, and R. A. Kiehl, "Self-assembly of metallic nanoparticle arrays by DNA scaffolding," J. Nanoparticle Research, Vol. 4, No. 4, pp. 313-317, August 2002.