A mix of tiny gold and viral particles -- and the DNA ties that bind them

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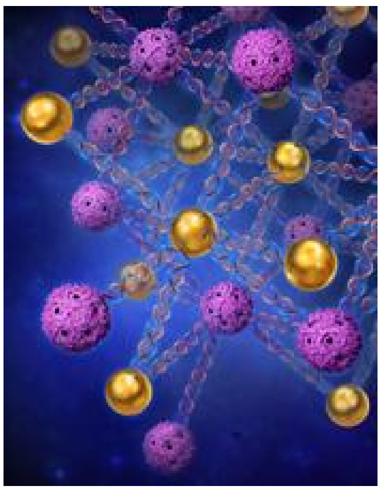

Crystal lattice created by Sung Yong Park and colleagues (Illustration by Adolf Lachman)

Scientists have created a diamond-like lattice composed of gold nanoparticles and viral particles, woven together and held in place by strands of DNA. The structure – a distinctive mix of hard, metallic nanoparticles and organic viral pieces known as capsids, linked by the very stuff of life, DNA – marks a remarkable step in scientists' ability to combine an assortment of materials to create infinitesimal devices.

The research, done by scientists at the University of Rochester Medical Center, Scripps Research Institute, and Massachusetts Institute of Technology, was published recently in *Nature Materials*.

While people commonly think of DNA as a blueprint for life, the team used DNA instead as a tool to guide the precise positioning of tiny particles just one-millionth of a centimeter across, using DNA to chaperone the particles.

Central to the work is the unique attraction of each of DNA's four chemical bases to just one other base. The scientists created specific pieces of DNA and then attached them to gold nanoparticles and viral particles, choosing the sequences and positioning them exactly to force the particles to arrange themselves into a crystal lattice.

When scientists mixed the particles, out of the brew emerged a sodium thallium crystal lattice. The device "self assembled" or literally built itself.

The research adds some welcome flexibility to the toolkit that scientists have available to create nano-sized devices.

"Organic materials interact in ways very different from metal nanoparticles. The fact that we were able to make such different materials work together and be compatible in a single structure demonstrates some new opportunities for building nano-sized devices," said Sung Yong Park, Ph.D., a research assistant professor of Biostatistics and Computational Biology at Rochester.

Park and M.G Finn, Ph.D., of Scripps Research Institute are corresponding authors of the paper.

Such a crystal lattice is potentially a central ingredient to a device known as a photonic crystal, which can manipulate light very precisely, blocking certain colors or wavelengths of light while letting other colors pass. While 3-D photonic crystals exist that can bend light at longer wavelengths, such as the infrared, this lattice is capable of manipulating visible light. Scientists foresee many applications for such crystals, such as optical computing and telecommunications, but manufacturing and durability remain serious challenges.

It was three years ago that Park, as part of a larger team of colleagues at Northwestern University, first produced a crystal lattice with a similar method, using DNA to link gold nanospheres. The new work is the first to combine particles with such different properties – hard gold nanoparticles and more flexible organic particles.

Within the new structure, there are actually two distinct forces at work, Park said. The gold particles and the viral particles repel each other, but their deterrence is countered by the attraction between the strategically placed complementary strands of DNA. Both phenomena play a role in creating the rigid crystal lattice. It's a little bit like how countering forces keep our curtains up: A spring in a curtain rod pushes the rod to lengthen, while brackets on the window frame counter that force, creating a taut, rigid device.

More information: www.nature.com/nmat/index.html

Provided by University of Rochester Medical Center

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