Gold nanoparticles arranged by custom DNA molecules to produce colors

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In this experiment, the gel is being activated by a red LED before the researchers measure the light it transmits. Credit: Joonas Ryssy

A new technology is using particles of gold to make colors. With further work, the method developed at Aalto University could herald a new display technology.

The technique uses gold nanocylinders suspended in a gel. The gel only transmits certain colors when lit by polarized light, and the color depends on the orientation of the gold nanocylinders. In a clever twist, a collaboration led by Anton Kuzyk's and Juho Pokki's research groups

used DNA molecules to control the orientation of gold nanocylinders in the gel.

"DNA isn't just an information carrier—it can also be a building block. We designed the DNA molecules to have a certain melting temperature, so we could basically program the material," says Aalto doctoral candidate Joonas Ryssy, the study's lead author. When the gel heats past the melting temperature, the DNA molecules loosen their grip and the gold nanocylinders change orientation. When the temperature drops, they tighten up again, and the nanoparticles go back to their original position.

The team tested several custom DNA molecules with different melting temperatures to find the best response. With the current system, the technology can produce red and green light. Once further work makes blue light transmission possible, this approach could be used to generate any color by mixing red, green, and blue.

"The whole concept—the underlying philosophy behind the work—is to use simple methods, simple materials and simple tools to generate colors in a dynamic and reversible way," says Sesha Manuguri, a postdoctoral researcher at Aalto who led the study.

For Manuguri, part of the elegance of the technique is that the gold nanocylinders accomplish both the necessary tasks. "The gold nanorods get hot when they're lit, heating the gel, and they're also responsible for color formation. So, you don't need separate heating elements," he says.

With further development, this approach could be used to produce color in different kinds of displays. Because the materials are all biocompatible, this could be ideal for displays on wearable sensor devices, but the technology could also be used in billboards or other displays.

"We've done the basic science to bring these building blocks together in a symbiotic manner to create something functional. Now it's up to engineers to explore what kind of devices could be made," says Manuguri.

The paper is available in *Advanced Functional Materials*.

More information: Joonas Ryssy et al, DNA-Engineered Hydrogels with Light-Adaptive Plasmonic Responses, *Advanced Functional Materials* (2022). DOI: 10.1002/adfm.202201249

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