# Researchers find way to align gold nanorods on a large scale

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Researchers from North Carolina State University have developed a simple, scalable way to align gold nanorods, particles with optical properties that could be used for emerging biomedical imaging technologies.

Aligning gold nanorods is important because they respond to light differently, depending on the direction in which the nanorods are pointed. To control the optical response of the nanorods, researchers want to ensure that all of the nanorods are aligned.

The NC State researchers developed a way to align the gold nanorods using electrospun polymer "nano/microfibers." Electrospinning is a way of producing fibers, with a liquid polymer being discharged from a needle and then solidifying. The researchers produced fibers as thin as 40 nanometers (nm) in diameter and as thick as three microns in diameter – thus, nano/microfibers.

The researchers mixed the gold nanorods into the polymer solution, causing them to be incorporated directly into the polymer. The nanorods align when the fibers form. The force experienced by the liquid polymer as it is emitted from the electrospinning needle creates "streamlines" in the polymer solution.

"The nanorods are forced into alignment with these streamlines, like logs in a river that swing into alignment with the current," says Dr. Joe Tracy, an assistant professor of materials science and engineering at NC State

and co-author of a paper describing the study. "And as the polymer solidifies, the aligned nanorods are locked into place."

"Electrospinning efforts at NC State are world-class and have yielded a wide range of novel and functional materials," adds Dr. Rich Spontak, a professor of chemical and biomolecular engineering and materials science and engineering at NC State and paper co-author. "What makes this result truly exciting is that the alignment is multiscale, or simultaneously achieved at different length scales. The nanorods are aligned at nanoscale dimensions, whereas the fibers are aligned at larger length scales."

This approach has been used in the past to align other kinds of nanorods, but this is the first time it has been done with gold nanorods. "To the best of our knowledge, this is also the first time nanorods of this size have been aligned in electrospun fibers," Tracy says, referring to the fact that the study focused on relatively short nanorods.

Specifically, the researchers used nanorods with an aspect ratio of 3.1. For example, that means that a nanorod measuring 10 nm wide would be 31 nm long. The nanorods in the study were approximately 49 nm long.

This aspect ratio is important, because it affects the way the nanorods interact with light – and, therefore, their optical properties.

**More information:** The paper, "Long-Range Alignment of Gold Nanorods in Electrospun Polymer Nano/Microfibers," was published online Aug. 11 in *Langmuir*.

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