Researchers at North Carolina State University, US, have used a molecular template to create a gradient of gold nanoparticles on a silica-covered silicon surface. The scientists claim this is the first evidence that nanoparticles can form a gradient of decreasing concentration along a surface.

"This material promises to be the first in a series, with many applications in electronics, chemistry and the life sciences," said Rajendra Bhat of North Carolina State University.

To make the film, the team deposited a thin layer of organosilane molecules on a rectangular silica surface. As part of this process, a source close to one side of the substrate emitted the molecules in vapour form. As the distance from the substrate to the source increased, the concentration of molecules falling onto the surface decreased, creating a gradient.

Then the researchers dipped the substrate in a solution containing gold nanoparticles, each coated with a negatively charged chemical. The nanoparticles attached themselves to the positively charged tails of the organosilane molecules.

The scientists tested the material at the National Synchrotron Light Source at the US Department of Energy's Brookhaven National Laboratory. They used atomic-force microscopy to examine the gradient of gold particles, and near-edge X-ray absorption fine structure (NEXAFS) to look at the distribution of the organosilane molecules.

"We needed to confirm that both the gold particles and the sticky groups followed the same underlying gradient template," said Bhat. "The results from both techniques were expected to coincide if the particles were attaching to the underlying layer of sticky molecules. Our results show exactly that."

The researchers say the main advantage of the technique is that large numbers of structures can be combined on a single substrate and used for high-throughput processing. For example, when testing clusters of nanoparticles for use as catalysts, "clusters made of different numbers of nanoparticles could be put on a single surface, and scientists could test this surface just once in a
chemical reaction, instead of having to run each cluster separately through the reaction”. The material could also act as a sensor to detect species that have specific affinities for nanoparticles, and as a filter to select particles of given sizes.

The team reported its work in _Langmuir_. Now the scientists are working on different combinations of "sticky" substances and nanoparticles.

**About the author**

Liz Kalaugher is editor of _nanotechweb.org_.

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