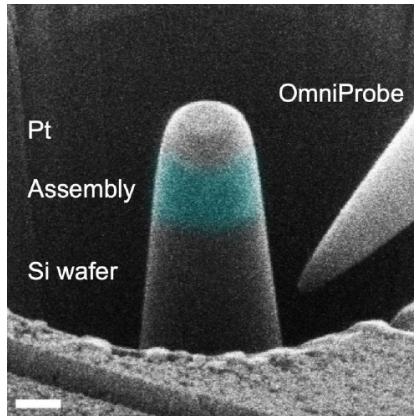
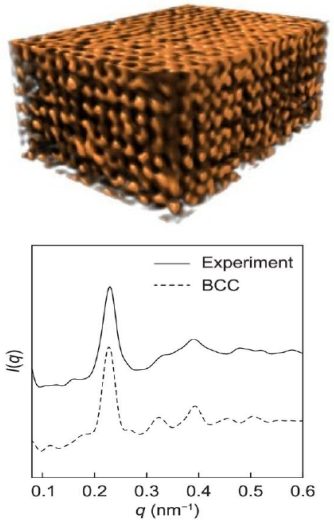
Patchy Nanoparticles by Atomic Stenciling





(Left) *A focused ion beam (FIB) was used to prepare the sample for X-ray nanotomography at the HXN beamline.* ***(Right, top)*** *X-ray tomography of patchy rhombic dodecahedra assembly showing the positions of individual atoms.* ***(Right, bottom)*** *The scattering signal calculated from the tomography data matches a perfect scattering signal from the simulated body-centered cubic (BCC) lattice (dotted lines), confirming that the self-assembly of patchy rhombic dodecahedra forms a BCC lattice.*

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Work was performed in part at NSLS-II

Scientific Achievement

Scientists have developed a new way to "stencil" molecular patterns at the nanometer precision but here the mask is made of atoms adsorbed on a nanoparticle's surface with facet selectivity.

Significance and Impact

This new bottom-up, solution-based approach is less expensive, scalable, high precision, and works on curved or 3D objects—important for complex nanomaterials.

Research Details

- Created >20 distinct types of polymer-patched nanoparticles
- X-ray nanotomography at HXN revealed a BCC superlattice extending tens of layers deep, consistent with theory and simulations.
- The consistent superlattice formation on different substrates shows that interparticle interactions, not the substrate, control the assembly.