Researchers discover new way to design metal nanoparticle catalysts

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Tiny metal nanoparticles are used as catalysts in many reactions, from refining chemicals to producing polymers and biofuels. How well these nanoparticles perform as catalysts for these reactions depend on which of their crystal faces are exposed.

But previous attempts to design these nanoparticles by changing their shape have failed because the structures are unstable and will revert back to their equilibrium shape.

Now, researchers at Northwestern University's Institute for Catalysis in Energy Processing have discovered a new strategy for fabricating metal nanoparticles in catalysts that promises to enhance the selectivity and yield for a wide range of structure-sensitive catalytic reactions. The team, led by Laurence D. Marks, professor of materials science and engineering at the McCormick School of Engineering and Applied Science, discovered that they could design nanoparticles by designing the particle's support structure.

"Instead of trying to engineer the nanoparticles, we've engineered the substrate that the nanoparticle sits on," Marks said. "That changes what faces are exposed." Their results were published in February in the journal Nano Letters.

This solution was a bit of a discovery: the team created the nanoparticle samples, discovered that they didn't change their shape (as the laws of thermodynamics caused previously designed nanoparticles to do), then

set out figuring how it worked. It turns out that epitaxy — the relationship between the position of the atoms in the nanoparticle and the position of the atoms on the substrate — was more important to design than previously thought.

The team is currently testing the nanoparticles in a catalytic reactor, and early results look promising, Marks says. The nanoparticles appear to be stable enough to survive the rigors of long-term use as catalysts.

"It opens the door to designing better catalysts," Marks said. "This method could be used with a variety of different metal nanoparticles. It's a new strategy, and it could have a very big impact."

More information: The *Nano Letters* paper is titled "Oriented Catalytic Platinum Nanoparticles on High Surface Area Strontium Titanate Nanocuboids."

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