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Encapsulation of Platinum in Dendrimers

The high surface:volume ratios of platinum nanoparticles enhances their catalytic properties, and makes their production and utilisation of great importance. A successful sonochemical preparation of platinum nanoparticles is reported on page 108 of this journal.

Conventional routes for nanoparticle preparation include evaporation and condensation, and metal salts reduction, both requiring stabilisers of polymers, ligands or surfactants to control particle size and prevent agglomerisation, but which passivate the cluster surfaces. Clusters and colloids can also be prepared using templates of reverse micelles and porous membranes, but again passivation occurs unless the template is removed.

Now researchers from Texas A & M University have developed a method to produce a less passivated platinum catalyst by using a dendrimer as both stabiliser and template (M. Zhao and R. M. Crooks, *Adv. Mater.*, 1999, **11**, (3), 217–220). A fourth generation (G4) polyamidoamine (PAMAM) Starburst dendrimer was loaded with a predetermined amount of platinum(II) ions followed by reduction with BH_3. From 12 to 60 Pt nanoparticles may be inside each dendrimer without agglomeration for up to 150 days. The dendrimers are spherical, monodispersed, highly functionalised and branched, with an open centre and sterically crowded exterior. They can entrap the Pt ions and stabilise the clusters without totally passivating the surface. This hydroxyl-terminated dendrimer provides stability and size control to the Pt particles (diameter ~ 1.5 nm) and permits substrates to penetrate the interior and access the cluster.

When attached to gold electrodes, in the presence of O_2, Au/G4-OH(Pt_{60}) gives an enhanced catalytic current and a shift in peak potential to 75 mV, compared to a Au/G4-OH modified electrode. In the absence of O_2 only a small current is observed, confirming that O_2 reduction is taking place, and making this of potential interest for fuel cell catalysts.