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Colloidal Palladium/Nickel Bimetallic Clusters

Nanoscopic metal particles, such as clusters, have different properties to bulk metals. The dispersion of noble metal clusters can be achieved by reducing noble metal ions in water, in the presence of water-soluble polymers, such as poly(*N*-vinyl-2-pyrrolidone) (PVP). It is more difficult to produce clusters and colloids of non-noble metals. Palladium/copper clusters have been prepared, but nickel clusters have proved difficult.

Now, however, researchers at the University of Tokyo and the Science University of Tokyo, have managed to prepare colloidal dispersions of palladium/nickel bimetallic clusters by a modified polyol reduction method (N. Toshima and P. Lu, *Chem. Lett. Jpn.*, 1996, (9), 729–730).

At palladium molar contents of 20–80 per cent, the dispersions contained fine particles of narrow size distribution and average diameter 1.89 nm, with little aggregation, which suggested alloy structure formation. Both palladium-palladium and palladium-nickel bonds may exist simultaneously within each particle of the palladium/nickel bimetallic clusters.

The catalytic activity of the PVP-protected palladium/nickel colloids was studied during nitrobenzene hydrogenation to aniline. Clusters with palladium ratios ranging from 40–80 per cent had much higher catalytic activities than both nickel and palladium monometallic clusters. The palladium:nickel (3:2) colloid showed the highest activity, around 4.2 times that for monometallic palladium clusters. Interactions between palladium and nickel in the cluster may affect the catalytic activity.

Palladium Aids Insulator Metallisation

Minute copper and nickel patterns can be produced on glass, silica and other insulating materials by using laser-assisted surface activation.

Now investigators at the C.N.R.S., Marseille, France, have reported a simple process in which visible continuous-wave and pulsed lasers can activate spun-on seeding layers of palladium acetylacetonate dissolved in chloroform (G. A. Shafeev, J.-M. Themlin, L. Bellard, W. Marine and A. Cros, *J. Vac. Sci. Technol., A*, 1996, **14**, (2), 319–326). The focused laser beam changes the chemical state of the palladium precursor by pyrolysis. The patterned catalytic film can then promote electroless metal growth.

The quality of the adhesion of the metal deposit to the underlying insulator is very important, and this is determined by the palladium clusters formed when the laser beam activates the catalytic seeding layer. After thermal decomposition the remaining palladium atoms are bonded to one of the two acetylacetonate "wings" of the parent molecule. Removing these ligands by treatment with hot acetic acid allows wear-resistant metal deposits to be formed on insulators.