Putting Platinum Where It Counts

Early Understanding of Core-shell Nanoparticles

Scientific Achievement

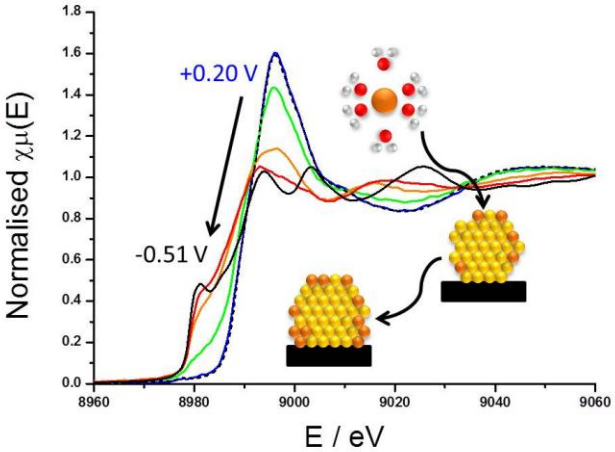
A study of copper deposition on gold nanoparticles found that copper shell coating gold core was incomplete, in contrast to results from model systems

Significance and Impact

First step in preparing platinum shell/gold core catalyst, which, by reducing placement of expensive platinum atoms, may be key to reducing cost of low-temperature fuel cells

Research Details

- X-ray absorption spectroscopy used to study deposition of copper on gold nanoparticles to see initial shell formation
- During deposition, gold core remained relatively unchanged, but local structure of copper went from hydrated ion in solution to more metallic atom surrounded by gold
- Amount of gold surrounding the copper showed that it first deposited into defect sites on the nanoparticle surface and then started to form clusters of copper around these initial sites, instead of the smooth shell predicted by single crystal studies
- Results will lead to better control of shell formation and, potentially, cheaper and more active core-shell catalysts



Cu K edge XANES spectra with schematic of Cu local environment from EXAFS showing the transition of the Cu from solvated species during underpotential deposition on Au nanoparticles.

SWT Price, JD Speed, P Kannan, AE Russell, *J. Am. Chem. Soc.* **2011**, 133, 19448–19458

Work was performed at Brookhaven National Laboratory