STRONG METAL SUPPORT INTERACTION IN GOLD SUPPORTED ZNO MESOCRYSTALS AND ITS CATALYSIS

Chung-Yuan Mou

Department of Chemistry, National Taiwan University, Taipei, 10617 Taiwan

Highly dispersed supported gold with strong metal support interaction is a desirable material for heterogeneous catalysis. Unlike current dispersion strategies of depositing gold from solution to support, we found a new method of producing highly dispersed gold clusters on ZnO mesocrystal. The gold clusters appeared on defect-rich twin-brush ZnO mesocrystals (TB-ZnO) via in-and-out process: (i) a mixed Au/Zn oxide was formed first after precipitation-deposition of Au with AuCl$_4^-$, (ii) Fine Au clusters grow from the underneath to surface of the oxide after heating. The TB-ZnO behaved like a sponge allowing gold atoms heavily dispersed into the wurtzite structure of ZnO with Zn-substitution by gold. After mild thermal treatment, the embedded gold emerged from the underneath of ZnO support to form highly dispersed Au nanoparticles of ~2 nm on ZnO surface. DFT calculation shows energetically favored Au-doping in TB-ZnO and facile defect-mediated migration of Au in it. The material (Au/TB-ZnO) gave outstanding activities for the catalysis of CO oxidation. The use of mesocrystals of metal oxide as supports, with rich vacancy defects, provides a new route for preparing highly dispersed and active supported metal catalysts. Further comparison with Au nanoparticle supported modulated defects density support a scenario of oxygen activation by defects where a Mars van Krevelen mechanism is responsible for high activity.

Reference: