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Aggregation-free gold nanoparticles in ordered mesoporous carbons: Towards highly active and stable heterogeneous catalysts for selective oxidation of alcohols and selective reduction of nitroarenes

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Carbon-supported catalysts have appeared more active than un-supported nanoparticles in oxidation of polyhydroxylated compounds, highlighting the importance of the relative affinity of the substrate and the support for aqueous media. However, activated carbon has been seldom used for gold deposition due to the facts that traditionally used methods for metal catalysts are unfeasible for gold nanoparticles. Here a coordination-assisted self-assembly approach is adopted for the intercalation of aggregation-free and monodispersed gold nanoparticles inside ordered mesoporous carbon frameworks.

An almost complete conversion of benzyl alcohol to benzoic acid is achieved within 60 min over the 9 nm-Au/C catalyst under 90 °C and 1 MPa, using potassium hydroxide as a base. Obvious changes are undetected for catalytic performance after five runs or in the presence of a thiol-containing mesoporous silca(SH-SBA-15) trapping agent. These results indicate that the gold-containing mesoporous carbon catalyst is stable and can be reused. A size-dependent selective oxidation over gold nanoparticles (3.4 - 17 nm) by the exposed surface atoms was observed at 0 °C, whereas the intrinsic activity at 25 °C was independent of size. The electronic modification of the *d*-orbitals of small particles is extremely important for chemisorption of O_2 at atmosphere pressure and low temperatures. In addition, the morphology of the intercalated gold nanoparticles is dramatically changed due to the carbon diffusion and CO adsorption during high-temperature carbonization. The generation of cluster-like structures, and stepped surface, which can generate new low coordinated gold atoms andpossibly reduce the H_2 dissociation barrier, can strongly improve the hydrogenation activity of supported gold catalysts.

Biography

Ying Wan completed each of her academic degrees in Industrial Catalysis from the East China University of Science and Technology, receiving her Ph.D. in 2002. Then, she joined Shanghai Normal University where she got a Professor position in 2006. Her current research focuses on sintering-, and poisoning-resistance metal nanocatalysts supported on mesoporous materials, and their applications in green organic synthesis. She has published 3 books as a co-author, 10 patent applications, and over 60 papers in reputed journals. She is now a co-Editor of Journal of Porous Materials.

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