Thoughts on the use of gold-based catalysts in environmental protection catalysis

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Gold catalysts for CO oxidation have been very well studied, particularly using titania as a support. Small nanoparticles of gold are implicated in the catalysis and support effects must also be present because there is a marked activity dependence of the support. Only gold-perovskites appear to show activity essentially identical to that of Au / titania, depending on the nature of the A and B elements present in the Au/ABO₃ structure. The low temperature activity of gold for the oxidation of hydrocarbons has also been demonstrated and it has been suggested that gold may well form the basis for active auto emission control catalysts for use at low temperatures, under cold start conditions. The economics of using gold rather than the platinum group elements are also considered to be attractive. Gold anions are associated with the defect sites present in titania, but undergo spontaneous partial reduction so that a variety of oxidation states may coexist in solid catalysts. The +1 oxidation state appears to correlate best with CO oxidation activity but a role for zerovalent gold may also be contemplated. It seems possible to thrif gold by the judicious use of cyanide extraction though this reaction is not simple. High temperature applications of gold catalysts such as auto emission control catalysts have been discussed but the simultaneous use of platinum complicates the understanding of just which entities are responsible for catalysis. Nanogold particle growth must be stopped or, at least controlled. Recently the use of nano-aligned rutile rods as a support for gold appears to offer a very convenient method for stabilizing nanogold. These catalysts show very limited growth of gold up to about 800 °C and offer a very real chance of designing gold only-based catalysts for emission control. The oxidation of CO remains very high even after exposure of the solids to high temperatures. The activity of gold for hydrocarbon oxidation is also well known, but the behaviour of gold in effecting NOx removal, though claimed, is less well studied. Applications in diesel exhaust systems, where device temperatures are likely to be lower are probably more immediately realizable than 3-way systems for gasoline emission control applications.

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Advanced Nano Routes to Clean and Sustainable Energy Havesting

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In this report, we present recent development in advanced nano routes to clean and sustainable energy harvesting. Emerging research and development of materials, design and integration of devices leads to innovations suitable for clean and sustainable energy harvesting from ambient. Due to both physical and quantum effects, nanoparticles are leading the efforts. Among them are segmented-in-series solid oxide fuel cells, polymer piezoelectric materials, and dye sensitized solar cells. Solid oxide fuel cells that operate at high temperature have attracted much attention for the advantages they offer. Piezoelectric energy harvesters have drawn attention as efficient transduction devices, which convert ambient vibrational energy into usable electrical energy. The efficiency of Grätzel cell can be further improved by the anchoring groups, such as COOH to be adsorbed onto the TiO₂ surface with a large electronic coupling. Heavy rare metal sensitizers are costly and environmentally detrimental. Natural sensitizers can be an alternative if they have acceptable efficiency in comparison to that one of transition coordination compounds and their extraction can be done by simple procedures from flowers, leaves, fruits, animals and other natural products. The wet-routes to nanoparticles functionalization will be reported with examples of selected cases.

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