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Atomic Layer Deposition (ALD) Preparation of Noble Metal Catalysts

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Status:

Patent pending; available for exclusive or non-exclusive licensing.

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Background

Organic pollutants in wastewater streams and volatile organic compounds in the atmosphere have been increasing over the recent decades. Currently, semiconductor photocatalysts such as Titanium Oxide (TiO_2), are used to minimize the effects of environmental pollution by detoxifying harmful organic materials. These photocatalysts are activated by UV light and break bonds in the contaminant to make it non-toxic. TiO_2 provides many benefits in use, as it is low cost, non-toxic, and has the ability to degrade a broad range of pollutants. However, TiO_2 is not used in environmental treatment because its low treatment efficiency prevents it from being used on a large scale.

The industry is continuously searching for catalytic developments. One development of interest is the use of mesoporous nanostructured materials. The surface of these nanostructures is very complex, giving it extremely high surface area and low density and providing many active sites for catalytic reactions. The material has promise for use in catalytic reforming for fuel production, fuel cells, batteries, pollution control and much more; however, the industry has had trouble coating these complex surface area materials. Current studies demonstrate the difficulty of coating substrates, especially complex high surface area materials, with noble metal nanoparticles due to the fact that the nanoparticles are not be dispersed uniformly. This poses a problem, as particle distribution within the substrate and on the surface of complex substrates is limited.

Technology

At the University of Colorado, a research team led by Dr. Alan Weimer has developed a method of using Atomic Layer Deposition (ALD) to create noble metal nanoparticles on high surface area materials. The noble metal nanoparticles are of uniform size, and are evenly disbursed on the high surface area particle, as well as within in the pores of high surface area particles. This is a technical breakthrough considering that current methods have proven unsuccessful in reaching the inner pores of the mesoporous gel and have shown poor dispersion and distribution.

Noble metal platinum can increase the efficiency of photocatalyst TiO_2; however, current methods of noble metal deposition cannot achieve the small and highly dispersed Pt nanoparticles that are necessary to realize this increased efficiency of TiO_2. Dr. Weimer's novel ALD method achieves the highly dispersed noble metal necessary to coat the TiO_2 particles, enabling it to be used as a photocatalyst to effectively break down toxic environmental contaminants.

Applications

This method of noble metal catalyst nanocoating introduces improved applications for noble metal catalysts that can be used in environmental remediation, water treatment, catalytic reforming for fuel production, fuel cells, batteries, and similar applications.

Patent Application
"Depositing Noble Metal Nanoparticles on High Surface Area Particles," filed 11/6/2009, available under CDA.