Department of

Chemical and Environmental Engineering

2015—2016 Seminar Series

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9:30-10:30am

Winston Chung Hall 205/206

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Chair, Distinguished Regents Professor

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Trapping precious metals on Ceria: Role of Surface Facets

As engines become more fuel efficient, and we use hybrid cars, the exhaust temperature is lowered, decreasing the amount of energy to conduct the catalytic conversion of automotive exhaust. Catalysts lose activity as they are used at high temperatures, hence improving the reactivity of the current generation of catalysts will have major impact on the overall efficiency of automotive transportation. Three-way catalysts (TWC) are used in the automotive industry to help reduce harmful emissions from automotive engines. Pt is utilized in diesel oxidation catalysts to oxidize carbon monoxide and hydrocarbons. Under oxidizing conditions at high temperatures, Pt is known to sinter and form large particles leading loss of catalytic activity. Recent work shows that Pt can be trapped by PdO forming Pt-Pd bimetallic particles that slow the rates of sintering.[1] While PdO gets reduced by Pt in these catalysts, we do not expect this to happen with more refractory oxides. Nonetheless, the formation of large particles can be avoided if we could trap the Pt in a dispersed form on a metal oxide. Ceria is a promising oxide since it has been reported that ceria can inhibit sintering of Pt at TWC operating conditions. In this research we have studied the effectiveness of ceria nanoshapes for trapping Pt. Since ceria is a crystalline oxide, it is possible to prepare particles of well-defined morphology, for example nanorods or cubes as shown in figure 1.[2] These particles expose well defined facets of ceria, the rods predominantly expose (111) surfaces while the cubes expose only (100) surfaces. Polyhedral ceria particles do not exhibit well defined surface facets. Hence, these surfaces provide very different efficiencies for trapping of Pt which is the subject of this research.

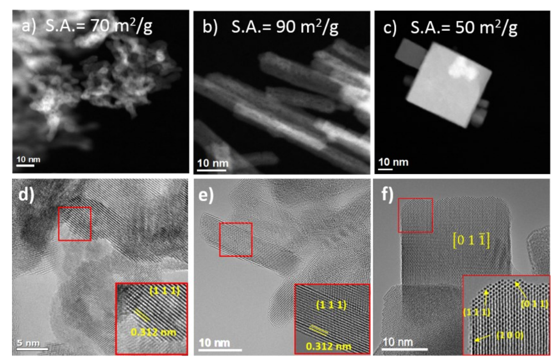

Figure 1: STEM and AC-TEM images of ceria polyhedral (a,d), nanorods (b,e) and cubes (c,f).

Biosketch: Abhaya Datye has been on the faculty at the University of New Mexico after receiving his PhD in Chemical Engineering at the University of Michigan in 1984. He is presently Chair of the department and Distinguished Regents Professor of Chemical & Biological Engineering. From 1994-2014 he served as Director of the Center for Microengineered Materials, a strategic research center at UNM that reports to the Vice President for Research. He is also the founding director of the graduate interdisciplinary program in Nanoscience and Microsystems, the first program at UNM to span three schools and colleges and the Anderson Business School. He served as director of this program from 2007 – 2014.

He has authored 220 refereed publications (h-index 52, 9219 citations - Google Scholar), 6 book chapters, 1 book, 5 patents, 71 conference proceedings, 147 invited talks. His awards & honors include: Elected fellow of the Microscopy Society of America, 2014; Fellow of the AIChE, 2015; Award for Excellence given by the NSF Industry University Cooperative Research Centers program, 2008; Chair of the Gordon research conference on Catalysis, 2010; UNM School of Engineering (SOE) Senior Teaching Excellence Award 2008, UNM SOE Senior Research Excellence Award, 1998, UNM SOE Junior Research Excellence Award, 1989.

His research interests are in heterogeneous catalysis, materials characterization and nanomaterials synthesis. His research group has pioneered the development of electron microscopy tools for the study of catalysts. Current research involves fundamental studies of catalyst sintering, the catalytic properties of single atom and sub-nm metal particles, the synthesis of biorenewable chemicals and of novel nanostructured heterogeneous catalysts for improved hydrothermal stability for aqueous phase and high temperature reactions.

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