BERKELEY CATALYSIS CENTER

Seminar

Monday, October 10, 2005 4 pm
The McCollum Room
775 B Tan Hall

Sotiris E. Pratsinis

Particle Technology Laboratory, Institute of Process Engineering
Department of Mechanical & Process Engineering
Swiss Federal Institute of Technology (ETH Zurich)

Flame aerosol synthesis of catalytic nanomaterials

ABSTRACT:

Recent breakthroughs in aerosol and combustion science and engineering allow now closely controlled synthesis of sophisticated mixed ceramic and noble metal composite nanoparticles. These materials seemed impossible to make in the gas phase just a few years ago. For example, excellent DeNOx catalysts, thin oligomeric V2O5 films over TiO2 particles, are made by a scalable technology in one step. Likewise titania-doped silica catalysts of high selectivity for olefin epoxidation are made as they solely contain the active 4-atom coordinated Ti. Next, applications of flame technology to synthesis of noble-metal clusters (Pt, Au or Ag) on ceramic (TiO2, SiO2 and Al2O3) nanoparticles will be shown. For example, the open structure of Pt/Al2O3 reduces mass transfer limitations resulting in more active than wet-made catalysts for synthesis of chiral molecules for pharmaceuticals from ethyl pyruvate.

Recently emphasis has been placed on single-step flame synthesis of Pt/CeO2/ZrO2 consisting of highly crystalline nanoparticles of 5-25 nm size grouped in small agglomerates. The BET surface area was around 150 m2/g as-prepared and 80 m2/g after calcination at 700 °C for 16 h. Doping with even small amounts of platinum increased the reversible oxygen exchange capacity compared to undoped CeO2-ZrO2. Fluorescence XAS proved to be well suited for identifying the structure of platinum although its concentration was only 0.1- 1 wt% in a strongly X-ray absorbing matrix. The structural identification at such small concentration turned out to be important since even small amounts of platinum have a strong influence on the reduction and the oxygen storage capacity of the CeO2-ZrO2 support.

Prof. Pratsinis received his Diploma in Chemical Engineering (1977) from the Aristotle University of Thessaloniki, Greece and his PhD ChE (1985) from UCLA with Sheldon Friedlander. He joined the ChE faculty at University of Cincinnati in 1985 where he was promoted to Professor in 1994. In 1998 he was elected Professor at the Swiss Federal Institute of Technology (ETH Zurich), Switzerland where he teaches and directs a research program on Particle Technology focusing on novel applications and materials through nanoparticle processing.