25 χρόνια ΕΙΧΗΜΥΘ: 1984 – 2009

ΣΕΜΙΝΑΡΙΟ

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Διακεκριμένη Ομιλία

ΟΜΙΛΗΤΗΣ: **Professor Sotiris E. Pratsinis**
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ΤΙΤΛΟΣ: **Core-Shell Nanoparticles: One-step Aerosol Synthesis and Coating**

ΤΟΠΟΣ: Αίθουσα Σεμιναρίων ΙΤΕ/ΕΙΧΗΜΥΘ

ΗΜΕΡΟΜΗΝΙΑ: Τετάρτη, 11 Φεβρουαρίου 2009

ΩΡΑ: 12:00

ΠΕΡΙΛΗΨΗ:

Aerosol routes are attractive for materials synthesis as they offer fewer process steps than conventional wet chemistry routes, easier particle collection from gaseous rather than liquid streams and no liquid by-products that require costly cleaning. In addition, aerosol-made particles and films have unique morphology and high purity (e.g. optical fibers) and even metastable phase composition contributing decisively to synthesis of a wide spectrum of sophisticated functional materials.

Today particulate commodities such as carbon blacks, fumed silica, alumina and titania are made by flame aerosol processes that had been developed largely by evolutionary or Edisonian research. Recent breakthroughs, however, in aerosol and combustion science allow now scalable flame synthesis of mixed oxides, metal salts and even pure metals as well as nanostructured, layered particles and solid or highly porous films with unique functionality contributing to manufacture of novel catalysts, gas sensors, phosphors, battery and fuel cell electrodes, nanocomposites dental prosthetics & even nutritional supplements!

Here, progress on one of the long standing challenges in flame aerosol synthesis of materials will be discussed: core-shell particles made in one-step. This has a number of applications in existing aerosol-made materials that have to be incorporated in a liquid (e.g. paints: a light-scattering core, TiO_2, coated by an inert thin shell, SiO_2) or polymer matrix (e.g. nanocomposites). Most importantly many promising applications of nanoparticles require core-shell structures (e.g. a magnetic Fe_2O_3 core coated by a thin SiO_2 shell). So rutile

Το σεμινάριο του διακεκριμένου Καθηγητή Σωτήρη Πρατσίνη εντάσσεται στο πλαίσιο εορτασμού των 25 χρόνων από την ίδρυση του ΙΤΕ/ΕΙΧΗΜΥΘ.

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titania nanoparticles made by a spray flame are hermetically coated by judiciously positioning a hollow ring that delivers swirling hexamethydisiloxane (HMDSO) vapour (precursor to SiO_2) through multiple jets. By systematic reactor design through computer fluid dynamic simulations, it is shown that increasing the jet mixing power can substantially improve the degree of mixing and quality of coating. The surface characteristics (zeta potential) of these nanothin SiO_2-coated rutile particles are different than those of either bulk TiO_2 or SiO_2. Certain IR vibrations (e.g. from Ti-O-Si bonds) are characteristic of these thinly-coated particles and can be used to distinguish between SiO_2-coating and free SiO_2 particles.

If time permits, model will be presented accounting for aerosol coagulation and sintering showing how flame process variables control shell thickness, texture and efficiency.

ΣΥΝΤΟΜΟ ΒΙΟΓΡΑΦΙΚΟ ΣΗΜΕΙΩΜΑ:

Professor Sotiris E. Pratsinis (Diploma, ChE, Aristotle Univ. Thessaloniki, 1977 & Ph.D., UCLA 1985) was born in Chanea, Krete in 1955. He was in the faculty (1985-2000) and interim Head (1998) of Chemical Engineering at the University of Cincinnati until he was elected Professor of Mechanical and Process Engineering (1998) and Adjunct Professor of Materials Science (2003) at the Swiss Federal Institute of Technology (ETH Zurich). There he founded the Particle Technology Laboratory and teaches Mass Transfer, Micro- & Nano-Particle Technology, Introduction to Nanoscale Engineering and Combustion Synthesis of Materials. Since 2007 he is Head of the Department of Mechanical and Process Engineering at ETH Zurich.

His research on particle dynamics focuses on the fundamentals of aerosol synthesis of materials with applications in catalysis, sensors and nanocomposites. He has published over 250 refereed journal articles with his students, received about a dozen European and U.S. patents licensed to various industries and contributed to creation of four spinoffs. He has been recognized by the 1988 Kenneth T. Whitby Award of the American Association of Aerosol Research, the 1989 Presidential Young Investigator Award from the U.S. National Science Foundation, the 1995 Marian Smoluchowski Award of the European Association for Aerosol Research and the 2003 Thomas Baron Award of the American Institute of Chemical Engineers. In 2005-06 he was appointed Russell Severance Springer Visiting Professor at the Mechanical Engineering Department of the University of California, Berkeley. He is on the Editorial Boards of the Journal of Nanoparticle Research, Particle and Particle Systems Characterization, KONA Powder and Particle, Powder Technology, Journal of Aerosol Science and Advanced Powder Technology. He is also on the Advisory Board of the Australian Research Council Centre on Functional Nanomaterials and on the Science Advisory Board of the Harvard School of Public Health - International Initiative for the Environment and Public Health.