Stevens Institute of Technology

Nanotechnology Graduate Program

Supercritical Fluid Aided Synthesis of Nano Structured Particles

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In the last two decades, there has been influx of new supercritical fluid aided material processing techniques for encapsulation, nucleation of particles/powders, impregnation of porous matrices, formation of porous materials, coating/spraying of flat surfaces, extrusion, comminution, and drying. The technical and economic drivers for using supercritical techniques are many. These processes usually employ a single material processing step. The solvating power and selectivity are tunable, enabling ease in separation of a particular component from a multi component mixture and complete solvent recovery with residue levels well below FDA thresholds. The gas like mobility of supercritical fluids allow very fast processing times, increasing throughput for a given equipment size. The low surface tension in the processing environment allows smooth coating and drying of surfaces. The popular supercritical solvent carbon dioxide is readily available, inexpensive, non-toxic, and allows near room temperature processing. Furthermore, CO2 in-activates a wide variety of bacterial organisms allowing sterilized final product. The global interest in supercritical fluids is primarily due to controllability and tunability of the processing environment to enable robust synthesis of materials with unique characteristics. On the other hand, our understanding and ability to predict the anomalities in the critical region and the capital charges associated with processing at high pressures hinder wider use of these techniques. Foundations and challenges in these novel materials synthesis techniques will be presented along with few select applications, including: Synthesis of nano structured energetic particles, encapsulation of nano particles, and synthesis of Nano structured photo catalysts.

Aydin K. Sunol is a Professor of Chemical and Biomedical Engineering at the University of South Florida. He was educated in Chemical Engineering (PhD from Va. Tech, 1982) and Industrial Engineering. He has edited three books on Batch Processing Systems, Artificial Intelligence in Engineering, and Pollution Prevention through Supercritical Fluids and over 100 publications and four patent portfolios. He has won departmental teaching award Virginia Tech (1981), the College of Engineering teaching award at USF (1984), and the University of South Florida Outstanding Teaching award (2003). He directed the NATO Advanced Study Institute on Batch Processing Systems (1991) and initiated the Artificial Intelligence program in Systems group of Technical Chemistry at ETH Zurich Switzerland (1990). He served as Tokten (Unesco) fellow to Turkey (1990). Dr. Sunol had industrial positions with ICI (UK), Ciba-Geigy and Sandoz (Switzerland), BASF (Germany) and Kimsas (Turkey) and academic positions at Virginia Tech, Bosphorous University (Turkey), ETH (Switzerland) and Princeton. At South Florida, he regularly teaches the capstone Plant and Product Design course as well as Thermodynamics, Mathematical Methods, and Separation Processes and Systems Engineering. He initiated the Green Engineering and Chemistry work group and course. The unifying theme of his research is in Supercritical Fluids and Systems Engineering is “Environmentally Friendly Engineering Systems”.

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