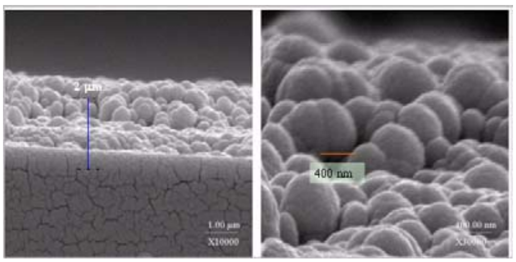
Ceramic and Composite Materials Center (CCMC)

University of New Mexico, Rutgers University
Professor William Koenke, Co-Director
Phone: 505-277-6824
E-mail: yonder@unm.edu.

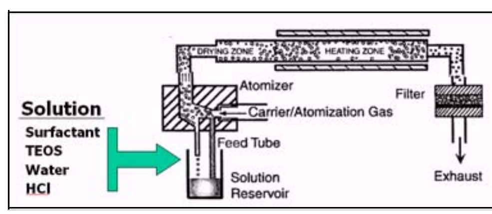
Ambient Pressure Technology



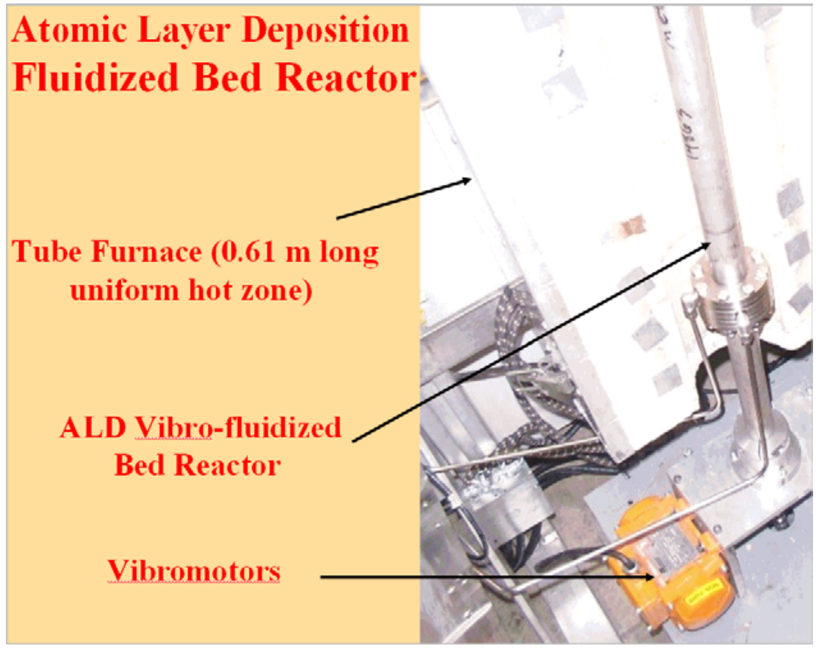
The Ceramic and Composite Materials Center (CCMC) has developed an ambient pressure process for making aerogels and xerogels. Previously these materials had to be made under critical conditions, a commercially unattractive process. This breakthrough technology spawned a spin-of company, NanoPore, which has developed into a multi-million dollar operation. The ambient pressure technology was patented and licensed to NanoPore, Hoechst, and Texas Instruments. Hoechst used it to develop a multimillion-dollar insulation manufacturing business that subsequently was sold to Cabot. Texas Instruments, TI, used the technology to develop insulation for microelectronic parts. Recently, TI reported copper wire interconnects protected with xerogel insulation for microelectronic devices. TI claims this to be a breakthrough technology that will enable copper wire interconnects to replace aluminum wire interconnects, the current industry standard. For more information, contact Professor William Koenke, 505-277-6824; e-mail: yonder@unm.edu.

Mesostructured and Nanostructured Materials

The pioneering studies of CCMC and Sandia National Laboratories to understand evaporation-induced self-assembly has led to the controlled synthesis, via self-organization processes, of mesostructured and nanostructured materials in the form of thin films and particles. These studies have developed two commercially important applications involving rapid prototyping of functional, hierarchical thin films via micropen lithography, ink-jet printing, and selective de-wetting. Two patent applications have been filed and licensing activities are in progress. For more information, contact Professor William Koenke, 505-277-6824; e-mail: yonder@unm.edu.



Atomic Layer Deposition Method to Coat Small Particles



The optimum chemistry for using Atomic Layer Deposition, ALD, to conformally coat fine particles of oxides, nonoxides, and metals with metal oxides has been established under vacuum conditions. The advantage of the ALD technique over other vapor coating processes is that it permits precise deposition of one monolayer at a time until the desired coating thickness is achieved. Scale-up of the method to make it commercially viable has been accomplished by developing a vibrating fluidized bed reactor to permit atomic layer deposition. Successful scale-up has moved the technology from a laboratory curiosity to a micro-pilot plant scale capable of coating hundreds of grams of powder with selective conformal coatings in a single run. The fluidized bed ALD reactor has been used to coat metal particles with conformal coatings of metal oxides and boron nitride particles. A patent has been filed, and a spin-off company, ALD Nanosolutions, has been formed to further develop the process and bring it to a commercially attractive level of performance. For more information, contact Professor William Koenke, 505-277-6824; e-mail: yonder@unm.edu.

"Mixedness" Software for Multi-component Particulate Systems

The center has developed an approach for simulating multicomponent particle mixtures. The method can be used to diagnose mixing problems related to poor selection of raw materials and to diagnose processing problems in which changing the particle size distribution could help a process meet design specifications. The approach, which has never been done before, can be used for nano-particles as well as large-scale particulate systems. CCMC researchers can perform direct comparison of simulations with experimental mixtures, and they can design mixtures, choosing the homogeneity scale, particle contact number, or the variance in the mixture, designated on any length scale. Applications of the method range from semiconductor materials to commodities such as detergents. CCMC researchers have been able to solve a variety of manufacturing problems by recommending simple changes in the manufacturing processes. One example is the case involving piezoelectric actuators for fuel injectors, in which they recommended a size distribution change introducing a specific size separation unit operation. This modification brought the process into the specification for the first time in 15 years.

Other significant problems solved by the "mixedness" engineering approach include cutting tool materials, ferrite materials, thermal management materials, detergents, and flow of powders. Most of the simulation work has been commercially utilized. The mixedness simulation software is now in the beta-testing phase: the software has been distributed to commercial entities for evaluation and feedback prior to commercialization. For more information, contact Riman, riman@alumina.rutgers.edu or Guerman Popov, 732-445-6760; e-mail: gpopov2@rci.rutgers.edu.