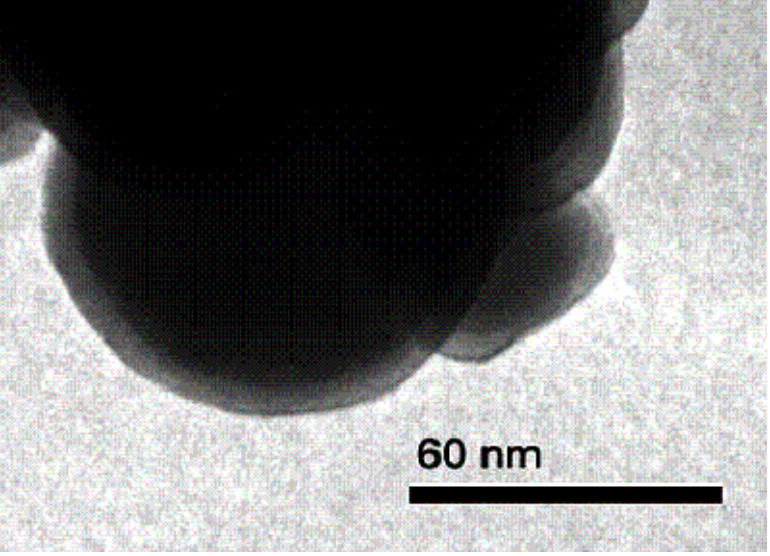

403b Coating Nanoparticles by Atomic Layer Deposition in a Rotary Fluidized Bed: Al_2O_3 Ald on Zro_2

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Ultrathin and conformal Al_2O_3 films have been grown by atomic layer deposition (ALD) on ZrO_2 particles with diameters of 60 nm and 400 nm using sequential exposures of trimethylaluminum and H_2O. This Al_2O_3 ALD on gram-scale quantities of high surface area ZrO_2 nanoparticles was performed in a novel rotary fluidized bed reactor. The rotary fluidized bed reactor consisted of a stainless steel porous metal cylinder that rotated inside a vacuum system. The nanoparticles were contained inside the porous metal cylinder and the gaseous reactants and products could easily diffuse through the porous walls without particle loss. A magnetically coupled rotary motion feedthrough rotated the porous metal cylinder and provided a fluidization-like mixing between the particles and the reactants. The Al_2O_3 ALD films were deposited on the ZrO_2 nanoparticles at 180°C with a growth rate of 1.8 Å/cycle. The composition of the Al_2O_3 ALD coating was verified using Auger electron spectroscopy, x-ray photoelectron spectroscopy and Fourier transform infrared spectroscopy. Transmission electron microscopy (TEM) and BET surface area analysis were utilized to determine the conformality of the Al_2O_3 ALD coating and to check for particle coalescence. As shown in the TEM image above, the Al_2O_3 ALD film uniformly coats the primary ZrO_2 particles. There was no evidence for any particle coalescence from the BET measurements.