Uniform, Thermal ALD of Al_2O_3 and ZnO on Zirconia Particles

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The technical literature contains relatively little on the topic of atomic layer deposition (ALD) on particles. Here we report thermal ALD of thin films of alumina and zinc oxide on zirconia powder substrates from trimethylaluminum and water, and diethylzinc and water, respectively. Very similar growth was obtained when ozone was substituted for water in these depositions. Depositions were optimized by varying the dose and purge times for the precursors with an aim to obtain uniform film thickness and growth per cycle (GPC). X-ray photoelectron spectroscopy (XPS) clearly showed an increase in surface aluminum and zinc with increasing numbers of ALD cycles. Transmission electron microscopy (TEM) showed uniform film growth and particle coverage. Film thicknesses were also measured on planar witness shards by spectroscopic ellipsometry (SE). Ultimately, up to 10 nm films of alumina and zinc oxide were grown on zirconia particles via 100 ALD cycles.