Surface Engineering of Particles and Powders by Atomic Layer Deposition

Geert Rampelberg, Véronique Cremers, Christophe Detavernier
Department of Solid State Sciences, Ghent University, Krijgslaan 281 (S1), B-9000 Ghent, Belgium
Geert.Rampelberg@UGent.be

Surface engineering of micro- and nanoparticles is of great importance in fields such as catalysis, energy and sensing. For many of these applications, particles are required with different bulk and surface properties. A popular technique to achieve this is to coat the particle surface with a nanometer thick layer. Only a few techniques have been explored for depositing such thin conformal coatings. Chemical vapor deposition (CVD) has been used extensively for this purpose, but suffers from some limitations, such as imperfect control over layer thickness and uniformity of the coating over all individual particles. In contrast, atomic layer deposition (ALD) is known as a reliable technique for covering complex 3D objects with ultrathin conformal coatings. At Ghent University a rotary reactor has been developed for applying ALD onto powders, particles and small parts. Ceramic and metal coatings have been successfully demonstrated on metal particles, polymer particles such as Teflon, porous catalyst supports, activated carbon, etc. The system has a kilogram-scale capacity but can be scaled up for industrial purposes. Furthermore, the system allows for plasma treatment and plasma-enhanced ALD for decreasing process costs. Complementary, a magnetron sputtering system (PVD) has been developed for coating particles. Currently, efforts are made for commercialization via a spin-off company.