

## Atomic Layer Deposition of Nanostructures

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Atomic Layer Deposition (ALD) is a unique thin film deposition technique based on chemical reactions of vaporized precursor chemicals on a given substrate surface. ALD is becoming an integral part of future intelligent manufacturing. This is due to the advantageous properties of the coating technology to grow dense and defect-free coatings conformally on flat and 3D surfaces, but also on nanostructures like nanoparticles and high aspect ratio structures.

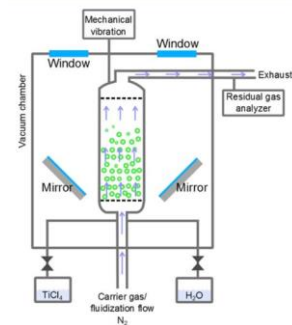
Nanostructures paying actual interest cover particles, nanotubes, porous membrane structures, nanoglass and nano-optical systems. By coating conformally these nanostructures, the lifetime, performance and safety can be improved with corrosion resistant coatings, optical coatings, passivation layers, barrier coatings, just to mention few.

Motivation for particle ALD is to improve stability of the nanoparticles without deteriorating the performance, while coating of high aspect ratio structures, new and improved features can be obtained. ALD also allows coating of porous structures up to 1:3000 and even higher aspect ratios.

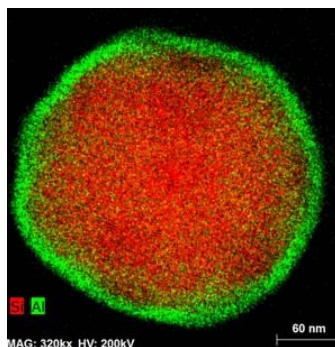
ALD equipment and related options to coat nanostructures will be presented. The interest is wide; coating of nanoparticles from 100 nm to microns size by Fluidized Bed Reactor ALD (Figures 1 and 2), to large particles by dedicated particle coating ALD reactor. Furthermore, different ALD equipment options are presented to coat high aspect ratio structures by reduced or full high aspect ratio samples.

Typical applications from Lithium-Ion Batteries and optics will be discussed. Ideas for different application areas of coated nanostructures are presented for further discussion and detailed studies.

### Figures



**Figure 1:** Beneq TFS 200 FBR option to coat particles from 100 nm to microns.



**Figure 2:** SiO<sub>2</sub> sphere coated with 15 nm Al<sub>2</sub>O<sub>3</sub> layer.