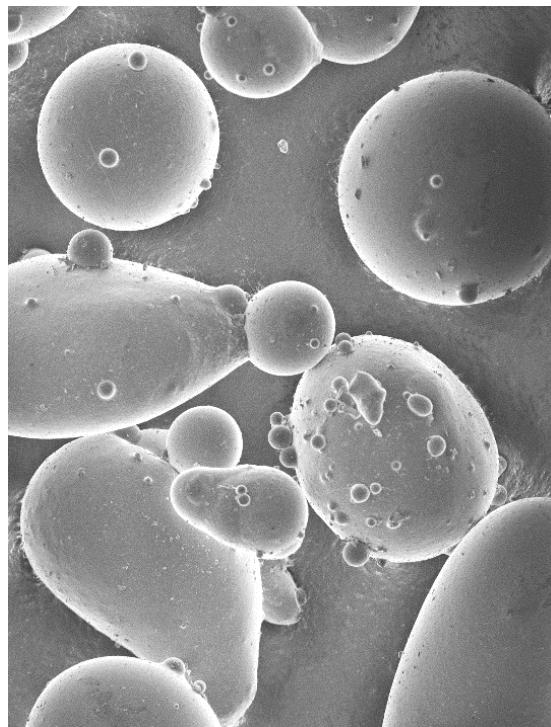


APPLICATION NOTE

Biocompatible ALD coatings for pharmaceuticals

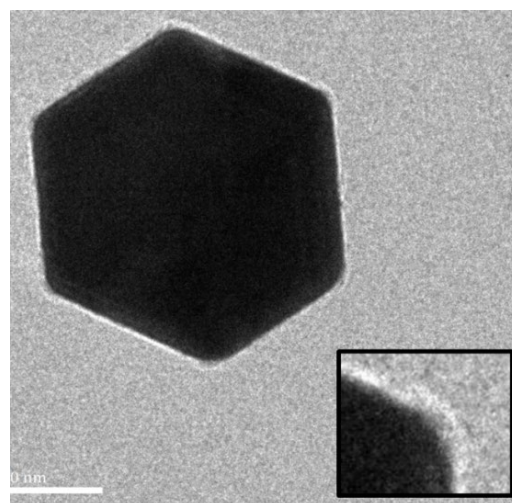
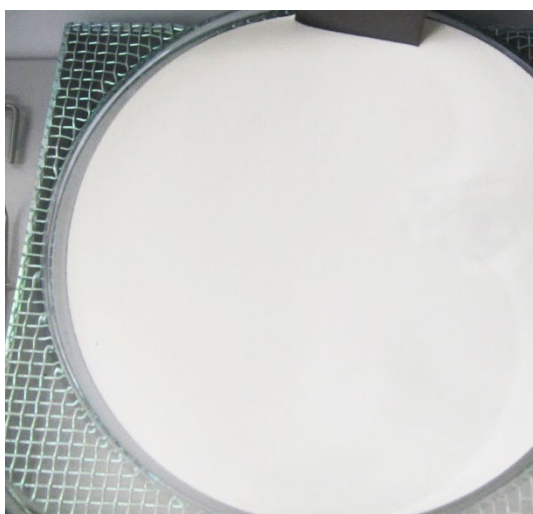


INTRODUCTION

- Picosun's Atomic Layer Deposition (ALD) technology offers a revolutionary way for drug particle surface modification for targeted and controlled drug release.
- ALD coating also protects the particles against ambient air and moisture, thus lengthening the drugs' shelf-life.
- Biocompatible ALD coatings are non-cytotoxic to human tissues.

ADVANTAGES OF PICOSUN'S BIOCOMPATIBLE ALD COATINGS FOR PHARMACEUTICALS INDUSTRIES

- ALD forms uniform and conformal coating on each particle individually.
- Controlled/targeted drug release is achieved with nanometer level, digitally repeatable thickness control of the coating.
- ALD films can be deposited on both hydrophilic and hydrophobic surfaces, (bio)polymer, metallic, ceramic and organic particles with sizes ranging from sub-micron to millimeters.
- ALD is a gentle, gas-phased coating method and process temperatures are moderate, which eliminates the risks for microscopic surface damage to the coated substances and makes the method suitable also for sensitive materials.
- Ultra-thin, only nanometer-scale ALD films are practically massless so they keep the powder properties, weight and surface area close to original.
- Endless surface modification possibilities can be achieved just by changing the ALD film material and/or thickness. Also nanolaminates and other layered/mixed/doped films can be manufactured.



ALD offers lots of alternatives for particle surface modification and functionalization. Left: ZrO_2 beads ready to be coated in a PICOSUN[®] ALD reactor. Right: Cu nanoparticles with uniform, conformal ALD oxide coating. Coating thickness on Cu nanoparticles 1 nm.

- Picosun provides a variety of biocompatible ALD materials: TiO_2 , Al_2O_3 , HfO_2 , SiO_2 , ZrO_2 , Nb_2O_5 , Ta_2O_5 , AlN and TiN (tested at FICAM – The Faculty of Medicine and Health Technology, University of Tampere, Finland with Cytotoxicity tests with cell culture medium according to the ISO 10993-5 standard, and 3 weeks soaking tests in PBS (phosphate-buffered saline) at 87 °C).
- Picosun's turn-key powder coating solutions are mature and production-proven in various manufacturing environments.
- Optional vibrational module in the coating equipment guarantees fully conformal coating on large batches up to 100 g range without agglomeration or sintering. Unlike with competing methods such as fluidized bed technique, Picosun's technology ensures no damage to the ALD film or the particle surface.



ABOUT PICOSUN AND ALD

Picosun is the leading provider of AGILE ALD[®] thin film coating solutions for global industries and prominent research organizations. PICOSUN[®] ALD equipment are used in wafer-based semiconductor industries such as IC components, LEDs and sensor manufacturing, powder materials processing, and coating of macroscopic 3D items such as machinery parts, medical implants and devices, watch parts and coins.

Picosun's history reaches back over four decades, to the invention of the ALD technology itself. Our exclusive dedication to ALD and the unmatched, Ph.D level expertise of our team make us your ideal partner in all your thin film coating needs!

ALD is the most sophisticated thin film coating method of today, and a key enabling technology in modern microelectronics industries. Ultra-thin ALD films have the highest conformality and uniformity down to nanometer-scale surface details and, thanks to the surface-controlled, self-limiting film growth mechanism, they are dense, crack- and pinhole-free. Several ALD materials are also intrinsically biocompatible and thus optimal for medical applications.

THE PRINCIPLE OF ALD



Introduction of molecules
containing element A.



Adsorption of the molecules
on the surface.



Introduction of molecules
containing element B and
reaction with element A on
the surface.



Completion of one
monolayer of compound AB.

Repeat cycle till desired film
thickness is reached.

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