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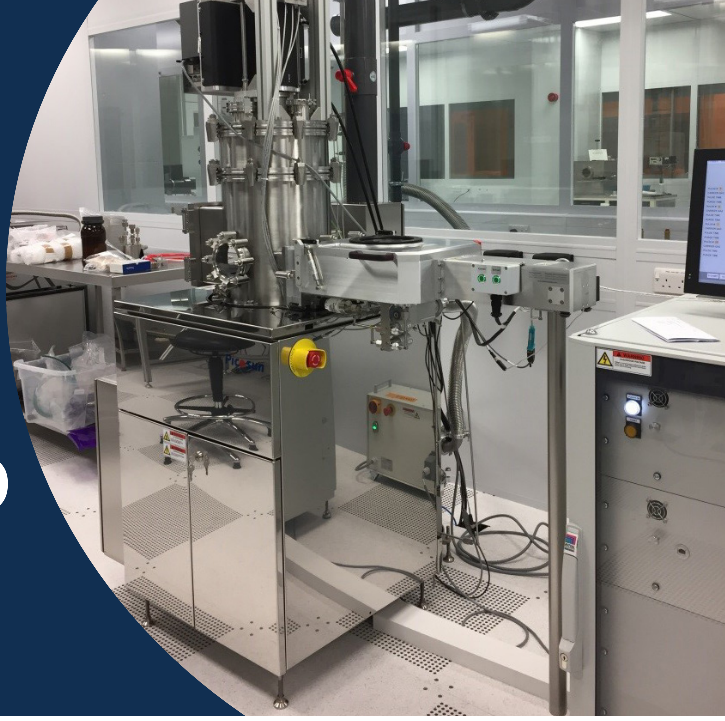

PLASMA-ENHANCED ATOMIC LAYER DEPOSITION (ALD)

Overview

Atomic layer deposition (ALD) is a gaseous deposition technique that allows the growth of highly crystalline films. This technique uses alternating gaseous precursors to allow for full monolayer growth, accessing thin films of only a couple of nm with high accuracy and reproducibility. The deposition is uniform over large areas on all uncovered surfaces.

Due to exploiting chemical reactivity, deposition temperatures and plasma powers can be much lower than other deposition techniques. With excellent conformity, 100% step coverage as well as uniform coatings on flat, inside porous, and around particle samples, ALD can provide a solution for difficult depositions on a variety of materials.

With cycling of reactants, abrupt interfaces can be achieved from substrate to film but with the capability of creating multilayer systems, there will also be abrupt interfaces between different multilayer structures. Employing a cycling recipe structure of reactants allows for fine control of the reactions but also gradient systems can be achieved by varying the timings of subsequent cycles to achieve different stoichiometric compositions within films.

Capability profile

System: Picosun ALD R-200 Advanced

ALD allows us to deposit a variety of dielectrics such as Al_2O_3, HfO_2 and also metallic films, with high degree of crystallinity and great control over exact deposition thicknesses. ALD is suitable for deposition on substrates or devices that require complete coverage over the whole exposed surface.

The applications of low-defect materials can have uses in a wide range of devices, for example, deposition of dielectric layers for gating various devices. Due to the pristine nature of the layer, higher gate voltages are available for

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probing. The ALD will be mainly be used in the latter stages of 2DM device fabrication, creating high-quality layers that can be used for tunnel barriers or encapsulation layers.

With low deposition temperatures, samples with materials of low thermal stability can be deposited on with little deterioration of existing layers. Due to the nature of the precursor delivery, the materials are grown while retaining the quality of the existing materials, with limited damage at the interface compared to other deposition techniques such as PECVD.

Capabilities of 3 liquid sources, 1 heated sources heated to maximum of 200°C and one solid source.

Current available sources include TMA, H_2O, TEMAHf, $TiCl_4$

5 plasma lines

Current available gases NH^3, N_2, H_2 O_2

Pulsing from 0.1s

Plasma power from 100W to 3000W

Samples size; up to 6” wafers with 4” “basket” attachment for non-wafer sizes

Samples heating from RT to 500°C

Capable of gradient systems - 6 cycled procurer settings

Load lock set up allowing for differtienal flows between inner chamber and intermediate space

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PICOFLOW™ Diffusion Enhancer provides stop flow functionality for lengthening the time available for precursor diffusion and surface reactions on substrates without risk of back-diffusion into source lines of the reaction chamber.

Hot source flow Boosting.

Ports available for set up of external real time growth characterisation tools.