

Atomic Layer Deposition Research Program

What is ALD?

Atomic layer deposition (ALD) is a thin film coating technology allowing nearly any material to be deposited onto complex, porous substrates. ALD is currently used by the semiconductor industry to mass produce microprocessors, disc drives, and memory chips. Argonne is working to extend this technology to new applications such as photovoltaics, catalysis, and batteries. The successful deployment of ALD technology into these markets will lower manufacturing costs, improve performance, and save energy.

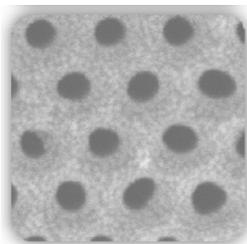
Target Applications



ALD test reactors

Photovoltaics: Energy Efficient Designs, Lower Cost

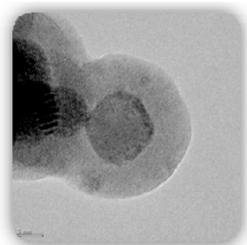
Transparent conducting oxide layers (In_2O_3 , ZnO , SnO_2), as well as semiconducting oxide films (TiO_2 , Fe_2O_3) deposited by ALD onto nanoporous scaffolds such as anodic alumina and silica aerogels, serve as efficient electrodes for inexpensive solar cells.



Anodic aluminum oxide catalytic membrane with 40 nm diameter pores

Catalysis: Higher Activity, Higher Selectivity

Anodic aluminum oxide membranes, nanopowders, and other high surface area templates coated by ALD shrink the pore or particle sizes to catalytically active dimensions (1-10 nm). Next, active catalytic layers (V_2O_5 , TiO_2 , Nb_2O_5) or nanoparticles (Pt, Pd, Ir) are deposited on the templates, yielding highly active catalysts for selective oxidation, hydrogenation, and other industrially-relevant processes.



Coated cathode nanoparticle

Batteries: Improved Performance and Safety

Metal oxide layers deposited over lithium-ion battery cathode materials protect the cathodes from electrochemical corrosion to improve the cyclability and safety of these energy storage devices.

Partnerships

Argonne's R&D program encompasses the full range from materials discovery, to device prototyping, to scale up, and finally to commercialization through industrial partnership.

Argonne is participating in three U.S. Department of Energy-funded Energy Frontier Research Centers to advance the basic science of ALD technology. These include: the Argonne-Northwestern Solar Energy Research Center (ANSER), the Institute for Atom-Efficient Chemical Transformations (IACT), and the Center for Electrical Energy Storage (CEES).

In addition, we are partnering with industry to scale up and commercialize ALD nanomanufacturing in these program areas.

For more information, contact

Jeffrey W. Elam

jelam@anl.gov

Web site: http://www.es.anl.gov/Energy_systems/Atomic_Layer_Deposition/Index.html



U.S. Department of Energy
Energy Efficiency
and Renewable Energy

Bringing you a prosperous future where energy
is clean, abundant, reliable, and affordable

Argonne National Laboratory is a U.S. Department of Energy laboratory managed by UChicago Argonne, LLC