

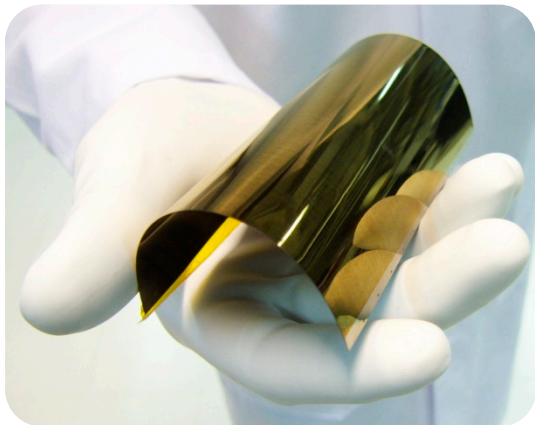


Corporate Presentation

March 2012



Equipment, Technology and Applications
for
Coating
in
Industry and Research



- Established:** 2005, Finland.
- Ownership:** Privately owned, venture capital financed.
- Products:** Industrial and research equipment for thin film coatings based on ALD (atomic layer deposition) and atmospheric aerosol (nHALO®, nAERO®) technologies. Strong application development and coating service offering. Comprehensive IPR-portfolio with more than 105 patent families.
- Markets:** Solar energy (photovoltaics and thermal), optical, flat glass (in-line and off-line), flexible and organic electronics, medical and lighting.
- Personnel:** 85
- Main office:** Vantaa (Helsinki), Finland.
- Sales offices:** Germany, China, USA (Beneq, Inc.).
- Sales Network:** 34 sales representatives in Europe, the Middle-East, Asia, Oceania and South-America.

Turning Innovations into Success.



For research

- For coatings, laminates, dopings etc.
- On metals, polymers, powders etc.
- With oxides, nitrides etc.
- Plasma-enhanced, rotating substrate, high-temperature, Roll-to-Roll, high aspect ratio substrates etc.



TFS 200
TFS 200R



TFS 500

For industry

- Industrial production
- Large-area/large batch coating
- In-line production lines
- Mass-coating deposition lines

ALD equipment for production:

- TFS NX300 (integrated mass-production)
 - surface passivation of c-Si solar cells
- TFS 600 (in-line production)
 - OLED encapsulation
- TFS 1200 (in-line) & TFS 1200B (batch) buffer layer for CIGS solar cells
- WCS 500 Roll-to-Roll ALD for flexible web coating



P400A and P800



TFS NX300

For research

- For nanoparticle synthesis and surface doping/modifications
- Research and corporate R&D



FCS 500

For industry

- Coatings for flat glass
- Large-area in-line coating
- Off-line coating systems



Beneq-Glaston TFC2000 (off-line TCO)

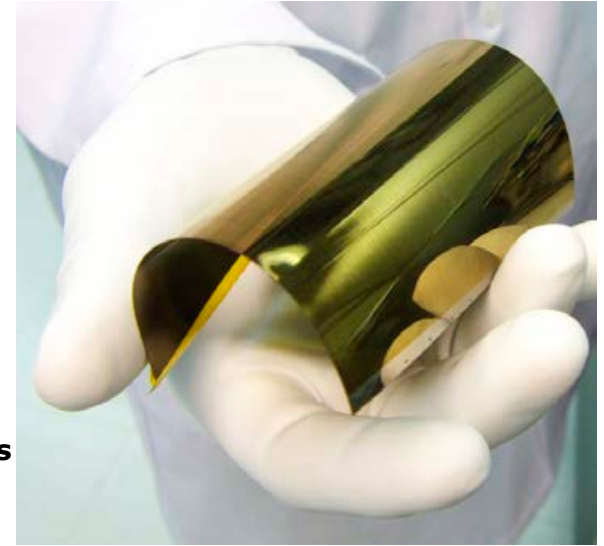
FCS 2000 (off-line)

FCS 4000F (in-line Low-e)



Solar energy

- Silicon based solar cells
 - c-Si, μ c-Si and a-Si
- Copper-indium-gallium-diselenide (CIGS) solar cells
- Cadmium-telluride (CdTe) solar cells
- Dye-sensitized solar cells (DSC)
- Organic PV
- Solar thermal (mirrors)



Flexible electronics

- Diffusion and moisture barriers
- Thin film encapsulation



Glass coatings

- In-line (float, patterned)
- Off-line (float, patterned)
- Strengthened glass for displays and touch screens
- Photovoltaics
- Table- and artware



Lighting

- LED
- OLED

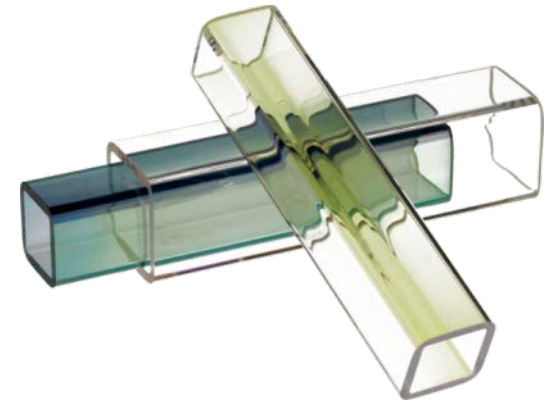


Particle ALD™

- Powder coatings
- Particle barrier coatings



Continuous ALD Roll-to-Roll ALD



Optical coatings

- Coloration
- Dielectric mirrors



Medical

- Instruments
- Implants



Ophthalmic coatings

- Decorative coatings
- Dichroic filters



Jewelry and minting

- protective coatings
- anti-tarnish coatings

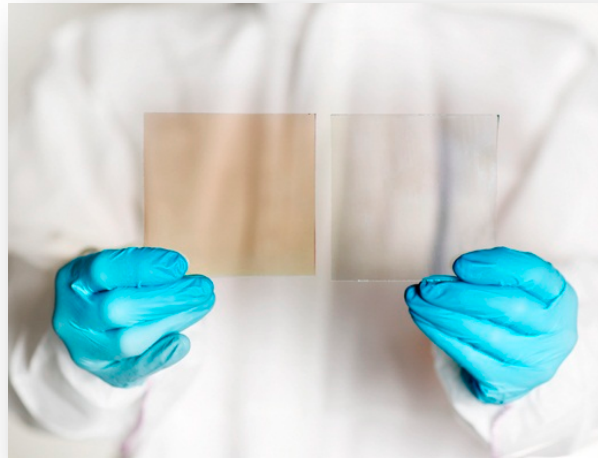
Extensive coating and development service offering enables

- Proof of concept and industrial feasibility
- Pilot-scale manufacturing



Identifying your opportunity

Application specific coating and material development services.



Finding the solutions

Verifying the process and determining industrial feasibility, including pilot production services.

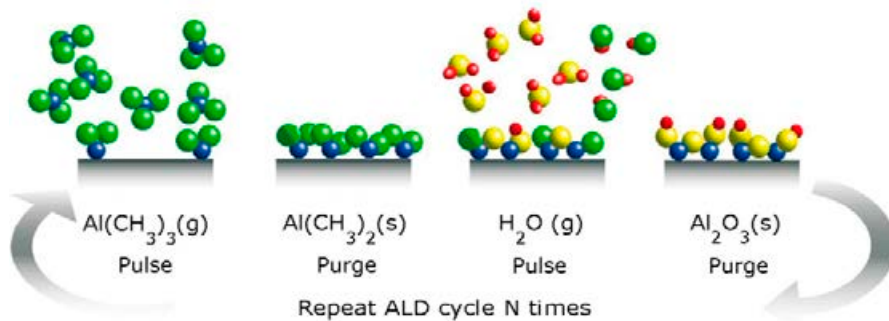


Building the equipment

Off-the-shelf as well as customer-specific equipment, built to deliver and last.

Beneq – Turning Innovations into Success.

Atomic layer deposition



ALD sequential (digital) deposition of Al_2O_3 .

Properties & Benefits

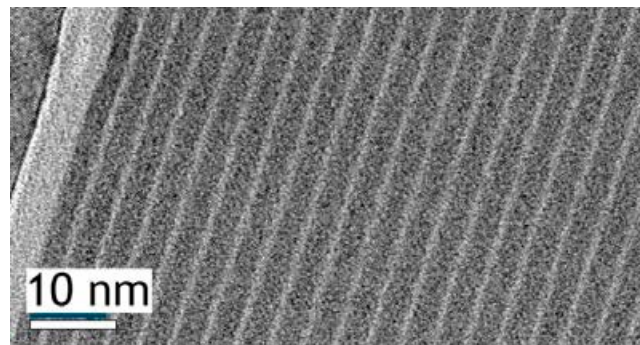
- Sequential vapor phase deposition
- Completely conformal, pinhole-free
- Nanoscale thickness accuracy
- Medium vacuum process
- Engineered new functional materials
- Repeatable and up-scalable

Applications (e.g.)

- Buffer layers, diffusion barriers
- Optics, dielectrics, medical, doping



Continuous ALD (Roll-to-Roll)



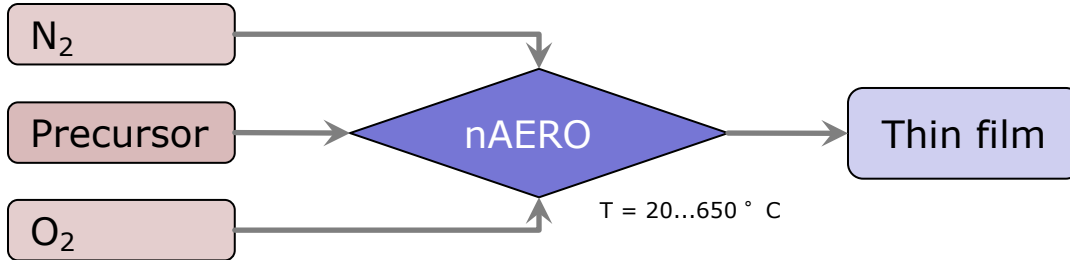
Nanolaminate manufactured by ALD

HRTEM image courtesy of Kauppinen & Jiang, Aalto Univ., (FI)



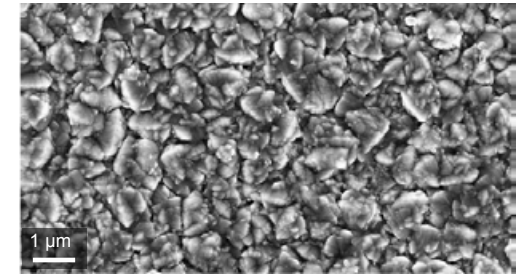
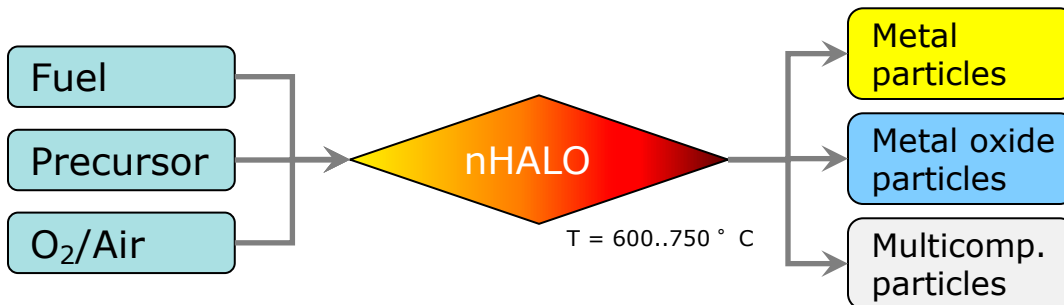
Plasma-enhanced ALD (PEALD)

Aerosol coating



Properties & Benefits

- Atmospheric coating technologies
- Sub-micron liquid precursor atomization
- Large area off-line and continuous in-line coating
- Applicable to existing production
- Thin films (nAERO®) and surface doping (nHALO®)



TCO (SnO₂:F) thin film on glass

Applications (e.g.)

- For glass
- TCO for PV, Low-e
 - Aerosol coatings



Glass colored by nHALO

Applications (e.g.)

- Particle synthesis
- Porous coatings
- Surface doping

For research

TFS 200

- Helsinki University (FI)
- Max Planck Institute (DE)
- IPHT Jena (DE)
- Cambridge University (UK)
- NASA Goddard Space Flight C. (US)
- Nat. Renewable Energy Lab. (US)
- Indian Institute of Science (IN)
- Tsinghua University (CN)
- Chinese Academy of Sciences (CN)
- Fudan University (CN)
- Tokyo Institute of Technology (JP)
- **+ many more units worldwide**

TFS 200R

- University of Lappeenranta (FI)

WCS 500

- University of Lappeenranta (FI)

TFS 500

- Aalto University (FI, 2 pcs)
- Inst. Nat. l'Énergie Solaire (FR)
- TU Dresden (DE)
- Fraunhofer IST (DE)
- Argonne National Lab. (US)
- **+ many more units worldwide**

FCS 500

- Metropolia (Appl. Sc.) Univ. (FI)
- Research Institute of Industrial Science & Technology (KR)

For industry

TFS 200

- General Atomics (US)
- Philips Technologie GmbH (DE)

TFS 500

- Kalevala Jewelry (FI)
- Ronda high-tech (IT)
- Group Marcel Robbez Masson (FR)

TFS 1200

- Thin film photovoltaic module manufacturer (EU)

TFS NX300

- c-Si photovoltaic module manufacturer

TFS 600

- OLED manufacturer (EU)

P400A and P800

- Planar Systems, Inc. (US)
- Flexible electronics manuf. (US)
- Display manufacturer (Asia)
- Fuel cell manufacturer (US)

FCS 500

- Float glass manufacturer (EU)

FCS 2000

- Photovoltaic glass manuf. (Asia)

Beneq-Glaston TFC2000™

- Photovoltaic glass manuf. (Asia)

FCS 4000F

- Float glass manufacturer (Asia)



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