

Scientific Expertise Beneficial to Business

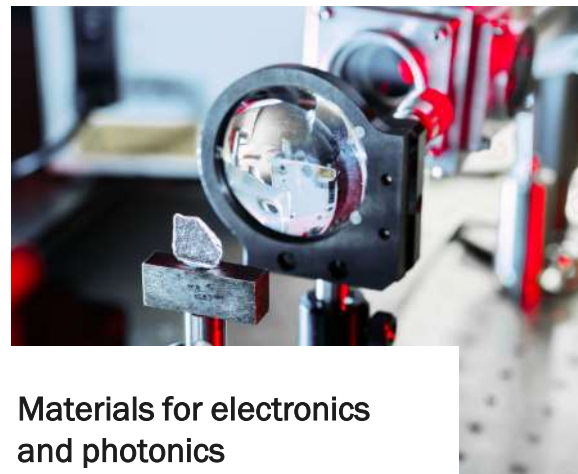
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40 Years of Expertise



Materials for energy
harvesting and storage



Materials for electronics
and photonics



Nanomaterials
and ceramics



Theoretical modelling
and design



Thin films and coating
technologies

Our offer

Innovation, technology and product development

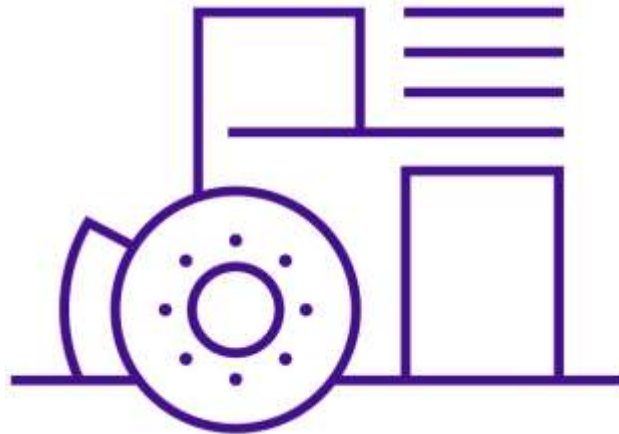
R&D services, testing & characterization

Prototyping and small-scale production

Industrialization up-scaling services

Together with our industrial partners

- **EuroLCDs** – thin films and coatings with LCD
- **Sidrabe** – vacuum coating devices, upscaling
- **GroGlass** – anti reflective glass
- **Schaeffler** – in-line coatings systems, antifiction, hardening and other coatings
- **Baltic Scientific Instruments** – radiation sensors and spectrometers
- **RD Alfa MD** – radiation resistant microelectronics
- **CeramOptec, Light Guide Optics** – custom made fiber optic components and products

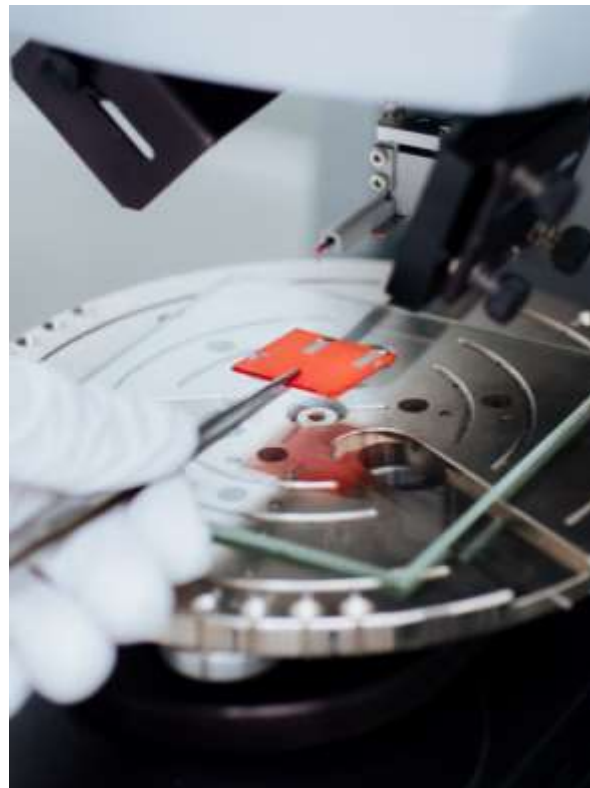


Thin films and coatings

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Thin films and coatings

- Thin films and coatings tuned for your applications:
 - photonics
 - sensors
 - batteries
 - catalysts
- Practically any materials and wide range of methods
- On time, flexible and customized process for client
- 40 experts in the field



Tools and techniques

- Thin film deposition cluster
- Magnetron sputtering complex
- Thermal evaporation cluster
- Plasma electrolytic oxidation
- Wet casting of materials
- Inhouse lithography technologies and characterization services



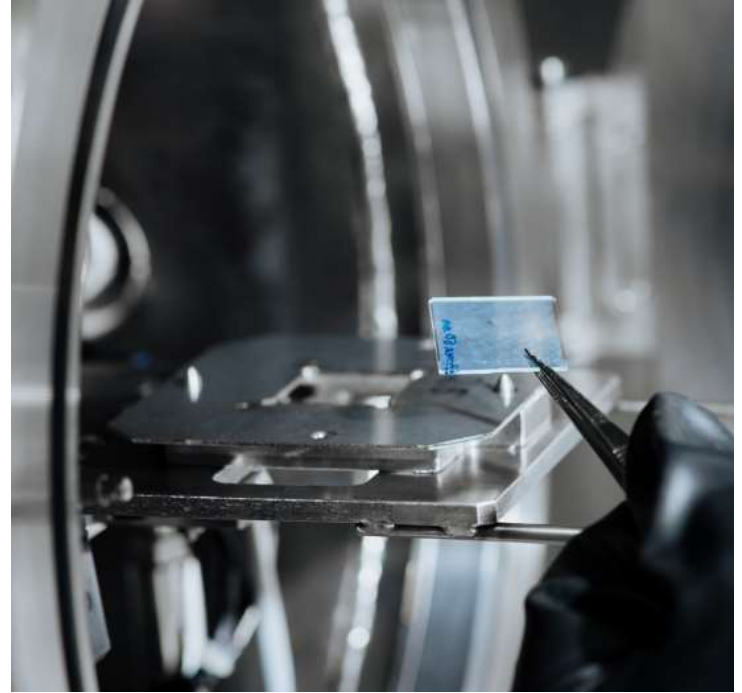
Thin film deposition cluster tool

- In ISO 7 cleanroom environment
- Highly customizable
- Magnetron sputtering (2 chambers)
 - DC, Pulsed-DC, RF, HiPIMS
- Low temperature evaporation
- High temperature evaporation
- E-beam evaporation



Thin film deposition cluster tool

- Various substrates (metal, glass, plastic, ceramic) with standard size 50x50x5mm
- Ar and oxygen plasma pre-treatment for substrate cleaning
- Contact and contactless heating and cooling
- Multi-layer stacks without venting
- Uniformity due to substrate rotation
- Thickness measurement (for evaporation)
- Base pressure 10^{-7} mbar
- Glovebox loading/unloading



Magnetron sputtering complex

- Two magnetron systems (DC, pulsed DC, RF, HiPIMS)
- Customized substrate size up to 50x100mm
- Substrate temperature: from liquid nitrogen to 800°C
- Substrate linear movement for homogeneity
- Substrate biasing available
- Ar+hydrogen (70/30), oxygen, nitrogen gases for reactive sputtering
- Time resolved optical plasma emission spectroscopy for process control
- In-situ thickness measurement during deposition



Thermal evaporation cluster

- Edwards Auto 306
 - substrate size up to 6" (diameter)
 - controllable substrate temperature
 - 2 high temperature sources
 - 2 low temperature sources
- Thermal evaporation tool
 - low material consumption
 - up to 6 layers without breaking vacuum
 - substrate size up to 25 x 25 mm
 - low temperature/high temperature evaporation
 - controllable substrate temperature



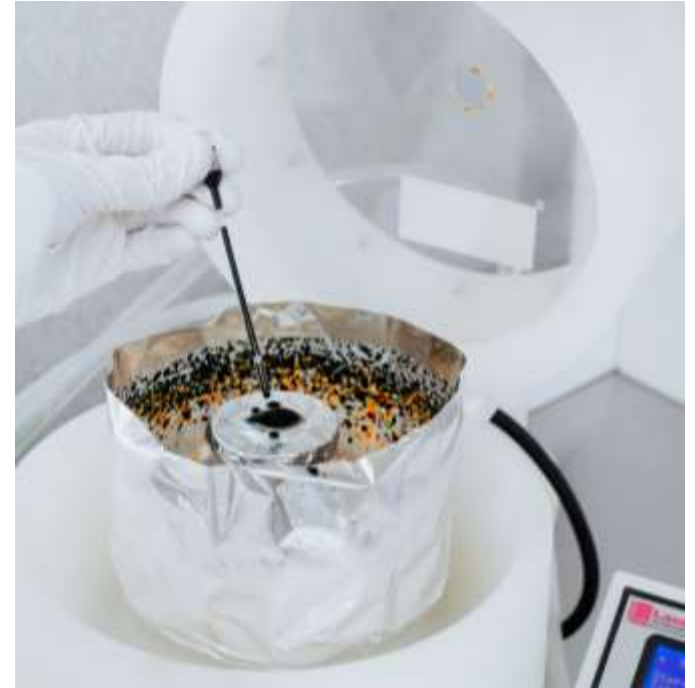
Lithography

- Optical lithography (direct laser writer, mask aligner)
- E-beam lithography - ultra high resolution
Raith eLINE Plus (<10 nm)
- Various applications incl., micro lenses, photonic crystals, micro and nano structures



Wet casting of materials

- Spin coating (in glovebox, Ar atmosphere)
- Spray coating
- Blade casting
- Dip coating
- Langmuir–Blodgett films
- Self assembling films
- Sol-gel process
- Ink-jet printing



Characterization

- Optical spectroscopy
- EPR spectroscopy
- Morphology analysis
- Electron microscopy (SEM, TEM)
- XRD & advances structure analysis
- Electrical & dielectric analysis
- Theoretical modelling



Examples

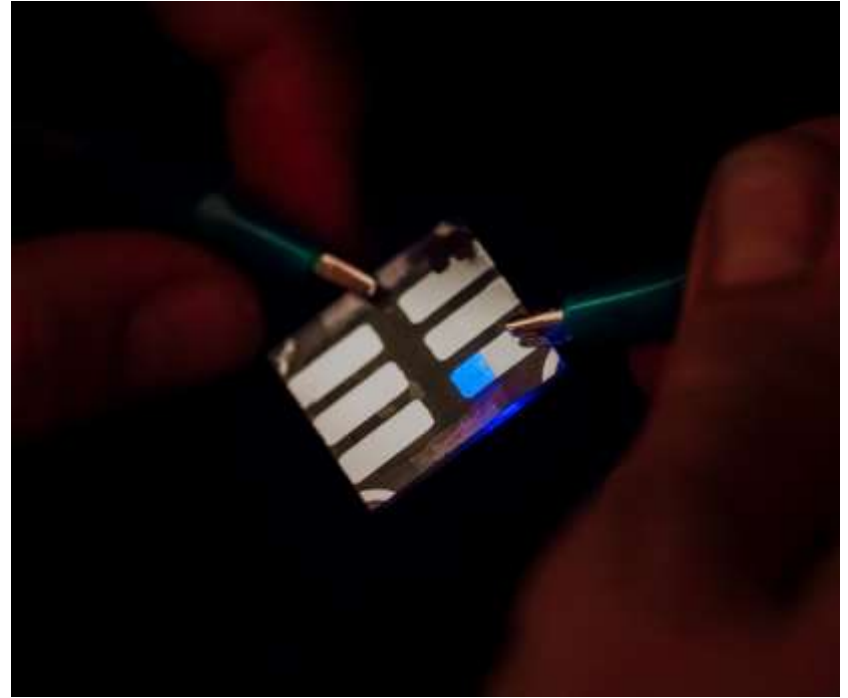
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Organic thin films for OLED

Full cycle of OLED development

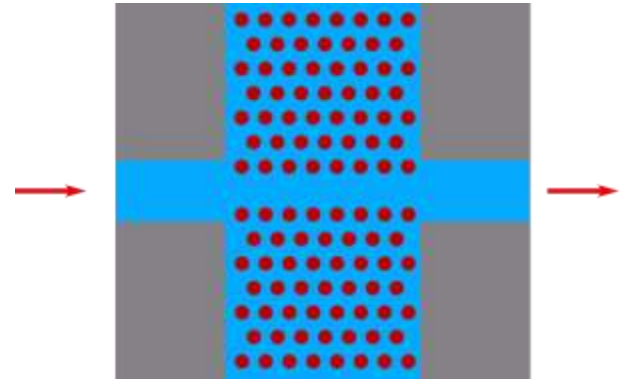
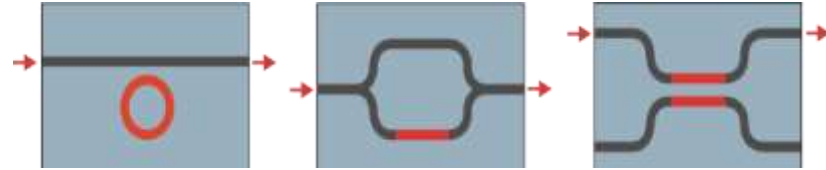
- Development
- Prototyping
- Characterization

Organic thin films using vacuum evaporation
and wet chemical coating



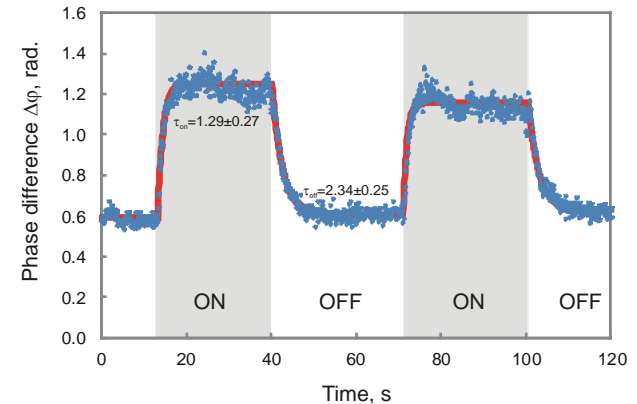
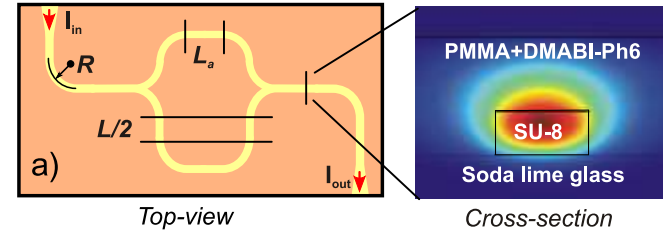
Optical waveguides

- Waveguide structures from SU-8 using lithography
- Electro-optical modulator devices
- Third-order nonlinear optical devices for light-to-light modulation



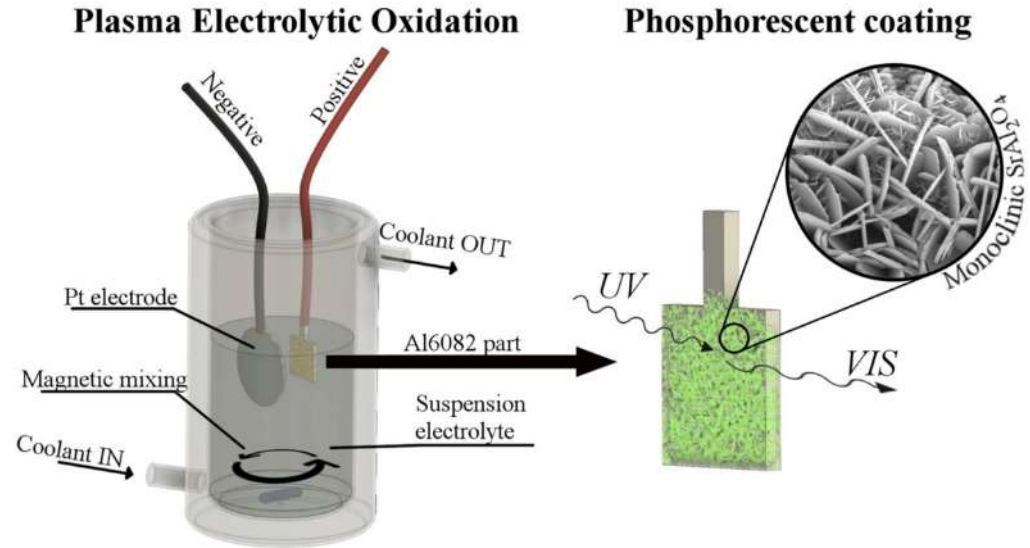
Asymmetrical all-organic waveguide gas sensor

- Stable, light guiding optical waveguide core with high refractive index
- Cladding material that is sensitive to environment and changes its refractive index
- Waveguide device was tested using N_2 gas (OFF state) and N_2 and isopropanol mixture (ON state)
- Optical lithography, spin-coating used



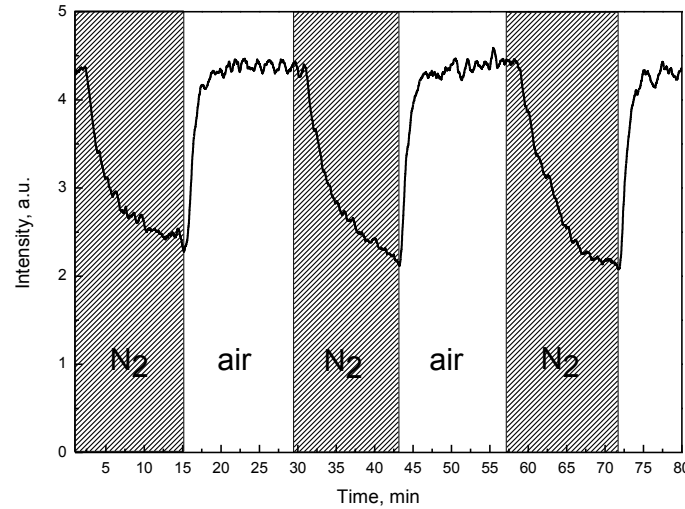
Phosphorescent coatings on metals

- Energy-efficient coating synthesis using plasma electrolytic oxidation (PEO)
- Long afterglow at room temperature
- Broad spectral distribution of luminescence in the visible range
- Road/emergency signs, road surface marking
- Direct coating on metal

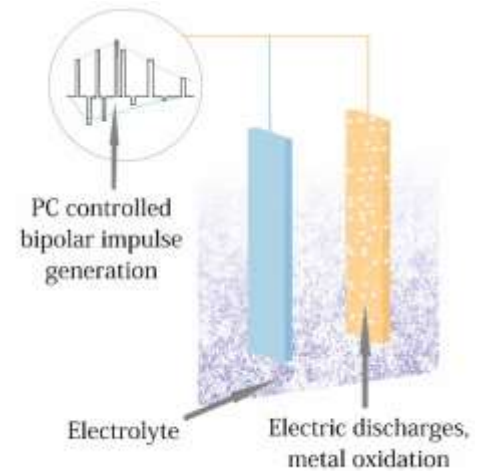


Oxygen sensing coatings

- Plasma electrolytic oxidation (PEO)
- Luminescent ZnO coatings



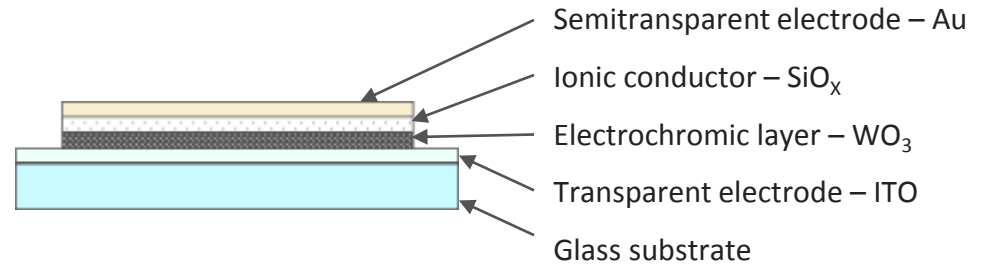
ZnO coating luminescence response to oxygen content



Plasma electrolytic oxidation

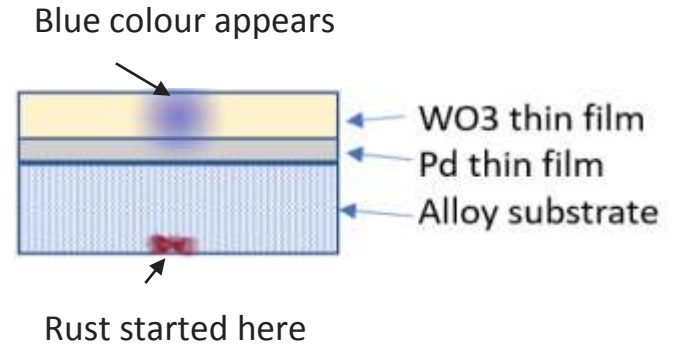
Electrochromic devices

- Electrochromic indication and information displays
- WO_3 as electrochromic material
- Thermal evaporation



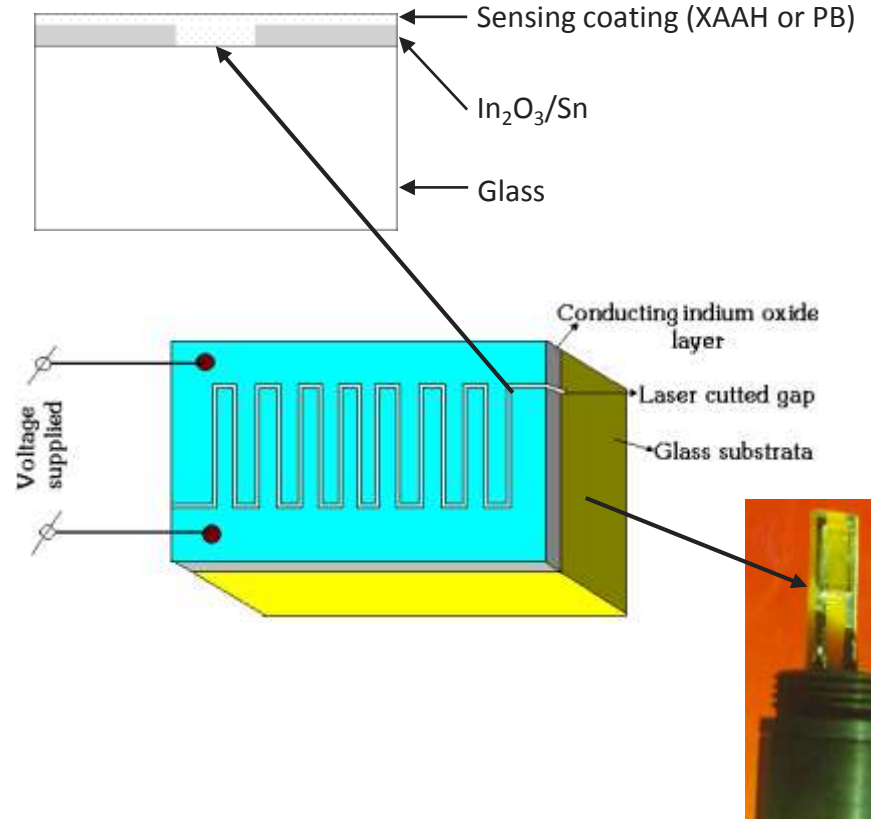
Visual rust indicator

- Determination of the starting point of the rusting process inside the steel tube
- Hydrogen ions are formed in the rusting process, which diffuses very quickly into steel and reaches the surface coating
- Physical vapor deposition



Humidity/gas sensor

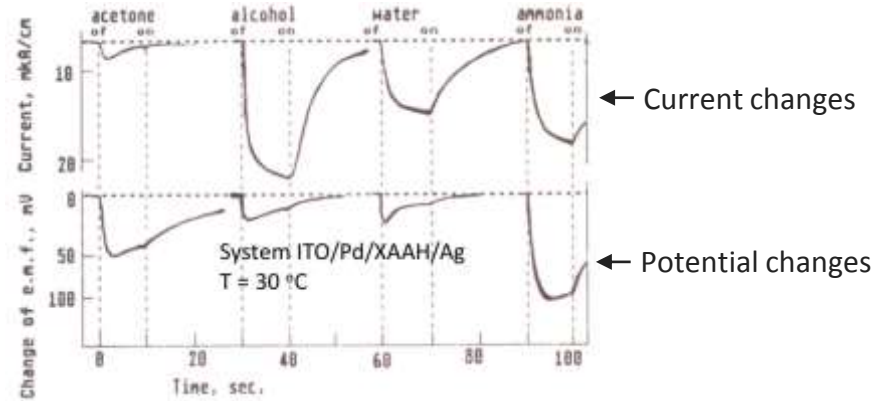
- Different coatings changes selectivity for gas sensing
 - XAAH (xerogel of antimononic acid hydrate) for ammonia,
 - PB (Prussian Blue) for ammonia or hydrogen
- Physical vapor deposition for PB
- Blade casting for XAAH



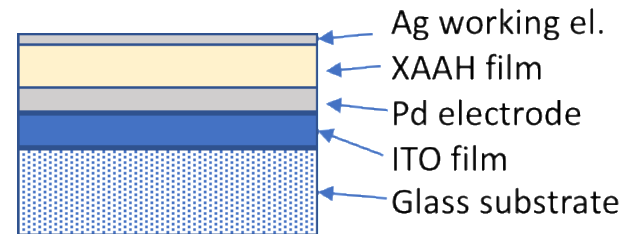
Antimonic acid hydrate as gas sensor

- XAAH layers are suitable materials for potentiometric and amperometric sensors, and it is possible to change selectivity by selecting definite material for a working electrode (1)
- Xerogel of $\text{Sb}_2\text{O}_5 \cdot n\text{H}_2\text{O}$ (XAAH) was prepared by hydrolysis of SbCl_5 followed by slow drying which turned it into the xerogel film (2)

(1)

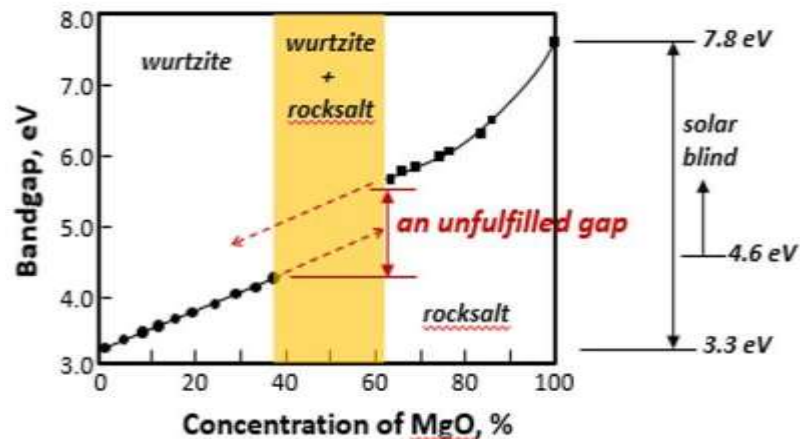


(2)



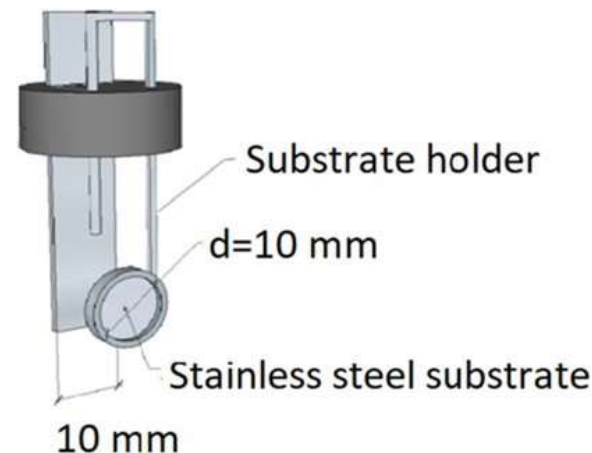
Thin films for solar-blind UV sensors

- ZnMgO materials with tunable band gap – significantly enhance the ability of the sensor to detect signals at different energies simultaneously
- For ozone detection, detectors for water purification, determination of pollution levels in any biological agent
- In collaboration with National Sun Yat-sen University, Taiwan



Metal oxide (TiO_2 , Fe_2O_3)-rGO composite as LIB anode

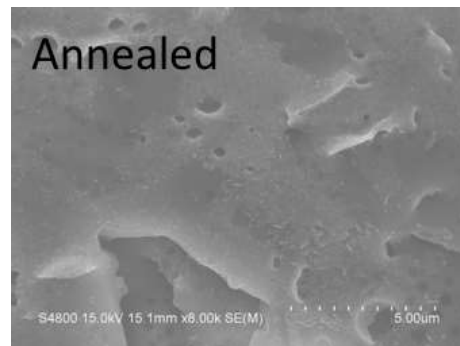
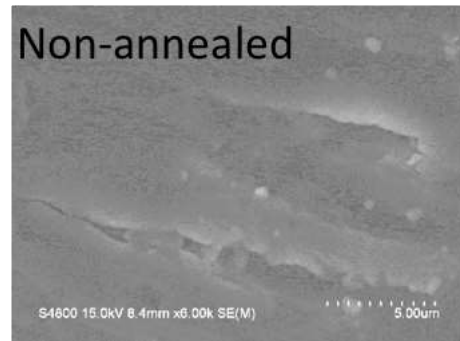
- Electrophoretic deposition or spray pyrolysis
- Used composite enhances charge capacity of battery



Scheme of electrophoretic deposition

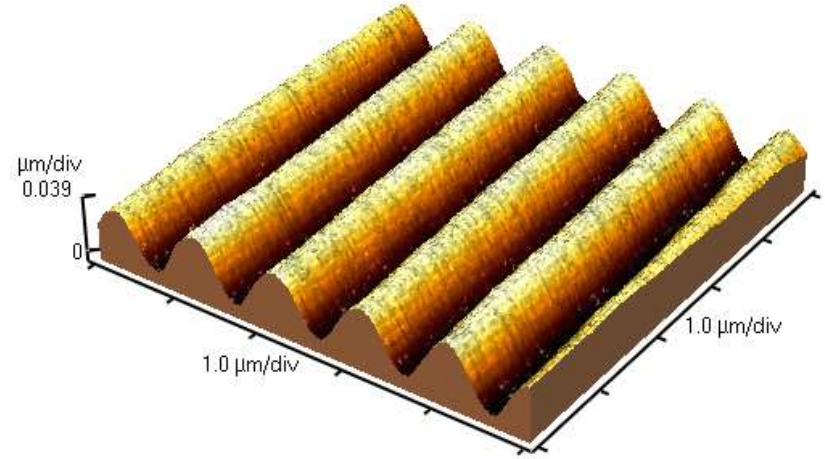
LiFePO₄ – rGO composite as LIB cathode

- Magnetron sputtered LiFePO₄ thin films
- Used composite enhances charge capacity of thin film layer
- No need for binder
- Increases proportion of active material
- Electrode for thin film batteries suitable for flexible electronics



Holographic recording

- Molecular glasses for holographic recording
- Surface-relief grating formation during holographic recording
- No chemical etching
- Electrochemical Ni-shim growing for printing

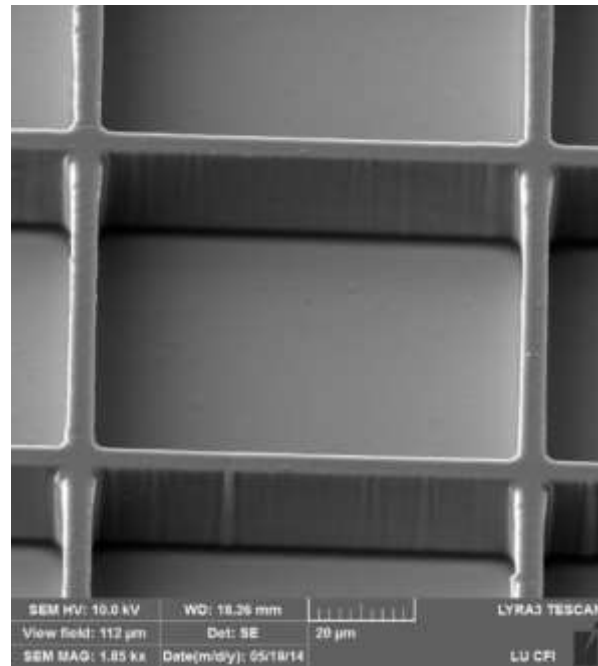


Our Partners

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EuroLCDs - LCD development

- High voltage liquid crystal display development
- Infrared liquid crystal shutters
- Displays with transparent pixel walls
- Thin film resistance and I-V characteristics, surface morphology, dielectric breakdown, spin-coating deposition, spectral measurements, mask aligner



EuroLCDs

- Own research, industrialization & manufacturing facilities
- Development of customized solutions
- World's fastest optical shutter technology ($< 0.1\text{ms}$)
- Bi-stable low energy consumption display
- Manufacturing technology of smart (switchable) glass products



Sidrabe: development & implementation of thin film technologies

- Customized vacuum coating systems
- Roll-to-roll systems for different materials, large 3D object in-line and batch coating systems, powder coating systems, cluster laboratory systems, systems for solar & battery applications



Sidrabe: customized R2R coaters

- AC/DC magnetron, e-beam & resistive evaporation, PECVD
- Single & double side single layers as well as multi-layer stacks
- Heating/cooling system of the process drums
- Multi-compartment chamber design
- Metal (magnetic & nonmagnetic) or ceramics target material
- Free web span during several runs, using reverse winding
- Low & smooth tension force profile for transportation



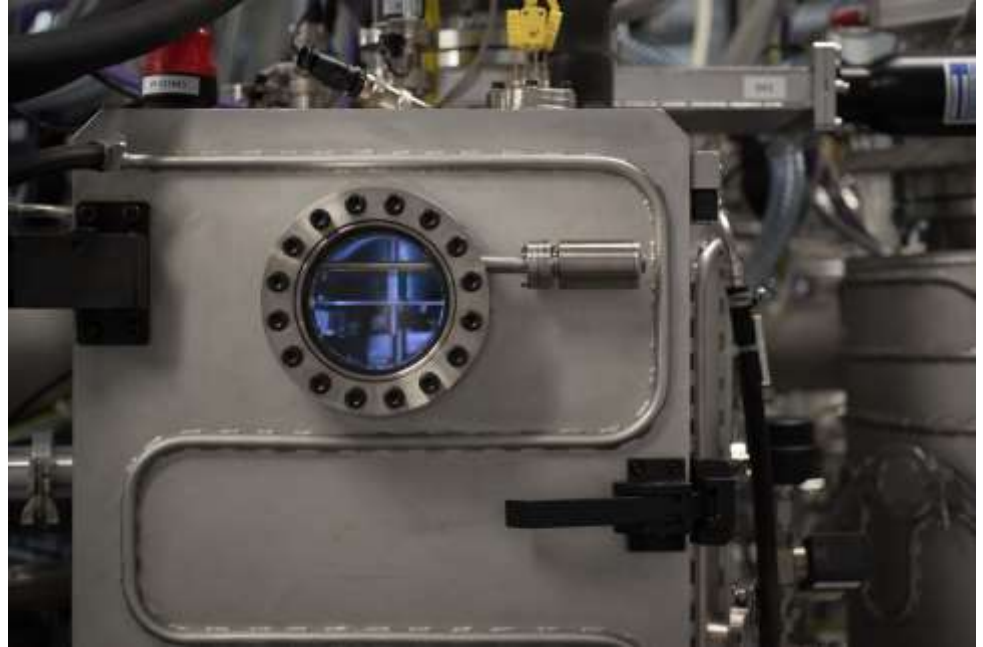
Groglass: functional glass coatings

- Anti-reflective & other high-performance coatings on glass and acryl
- Material and structure analysis (SEM-FIB, TEM) of thin coatings



Schaeffler: anti-friction coatings

- Development of anti-friction coatings for automotive industry
- Characterization and analysis of coatings



Welcome to collaborate

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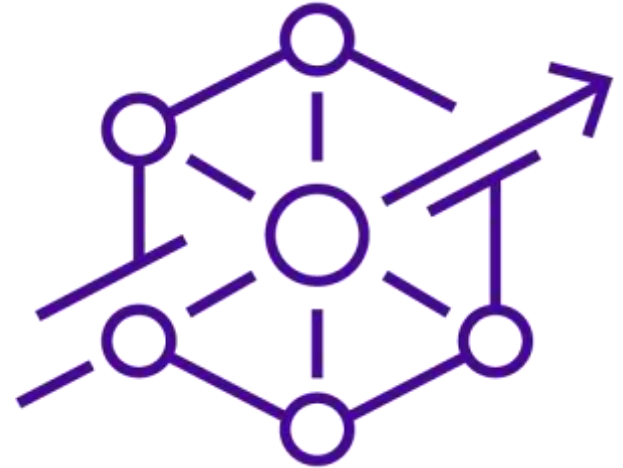
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and case studies
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Institute of Solid State Physics UL
industry collaboration and
innovation platform

- **Single point of contact** customer experience
- Talk with industry in **business language**
- **Pro-active** business / industry style projects management
- We make Scientific Expertise Beneficial to Business



Materize context

- Based in Latvia
- **Strong national innovation** eco-system player
- Strongest national materials research and innovation center
- **40 years** in material science from complex oxides to organic semiconductors
- Deep expertise in spectroscopy
- Prototyping laboratory with 680 m2 of **ISO class 7-8 cleanroom** facility
- 200 employees / **100 PhD**



Latvia Context

- **Member of European Union, NATO, OECD, WTO**
- EURO zone since Jan-2014
- Population – 2M, Baltics – 7M
- GDP annual growth – **4-5%**
- **100+** direct flight connections, including Israel
- **High stability and growth rating** –
by S&P, Moody's, World bank, IMF



What We Do



Prototyping and small scale
production



Research and development of
functional materials



Single point of
contact



Theoretical material design
and modelling



Environment for
innovations