CENTER FOR HYDROGEN ENERGY TECHNOLOGIES

Services provided

Plasma processing

- Low temperature plasma processing of metals, polymers, organic and other substances can be realised in one of the several vacuum chambers.

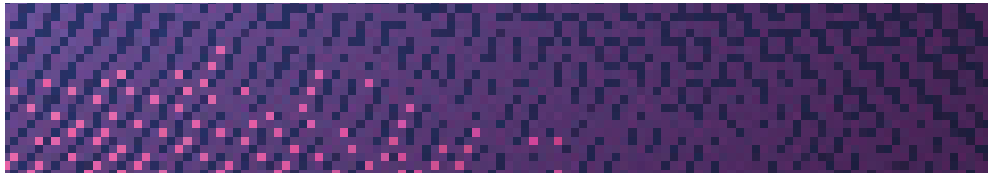
Thin film synthesis

- Films of various metals, semi-conductors, oxides, hydrides and other materials can be made by 3” and 4” magnetrons as well as E-beam evaporation processes in inert and reactive gas atmospheres.
- RF, DC and pulsed-DC power sources are available.

Analysis

Centre for Hydrogen Energy Technologies provides comprehensive sample analysis and structural characterisation services.

- Sample topology (SEM, optical microscopy, AFM and stylus profilometry).
- Crystal structure analysis at room and elevated temperatures (in-situ XRD in vacuum or selected gas environment with temperatures up to 1500 °C).
- Elemental and chemical composition analysis starting from the very top surface atomic monolayers (AES, XPS), through micrometre (EDS) and up to millimetre scale (GDOES).
- More specialised characterisation such as ionic-electronic conductivity, gas sorption kinetics and thermodynamics, precise N2, O2 and H2 amount measurements in metals, surface (micro) hardness and others.



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LITHUANIAN ENERGY INSTITUTE

NANOTECHNOLOGIES AND HYDROGEN RESEARCH

CENTER FOR HYDROGEN ENERGY TECHNOLOGIES

Areas of research

- RESEARCH IN THE FIELD OF HYDROGEN ENERGY TECHNOLOGIES
- SYNTHESIS OF HYDROGEN SEPARATION MEMBRANES AND ANALYSIS OF THEIR PROPERTIES
- HYDROGEN PRODUCTION USING WATER REACTIONS WITH METALS AND NANOPARTICLES OF THEIR ALLOYS
- SYNTHESIS OF METALS AND THEIR ALLOY HYDRIDES DESIGNED FOR HYDROGEN STORAGE; ANALYSIS OF THEIR PROPERTIES
- SYNTHESIS OF HYDROGEN FUEL CELL COMPONENTS (ANODES/ELECTRO-LYTES/CATHODES) APPLYING PHYSICAL VAPOUR DEPOSITION METHODS
- ANALYSIS OF NiMH BATTERY ELECTRODE MATERIAL PROPERTIES

Material synthesis

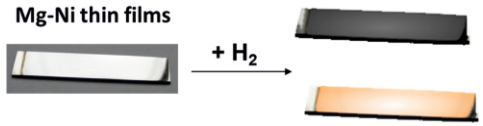
The researchers of LEI CHET have comprehensive experience in usage of physical technologies (magnetron sputtering, e-beam evaporation, PIII and other plasma based processes) for the synthesis of thin films and modification of surface properties.

During various international and national projects we have synthesised materials for the needs of various energy sectors (in particular hydrogen energy) and other applications (H2 gas separation membranes, electrodes for fuel cells).

Studies of the Mg based thin film hydrides

Investigation of thin films of Mg_2NiH_4 hydride has showed that the hydride displays different physical and thermo-dynamical properties in comparison to the corresponding powder samples. Many attempts have been undertaken to understand the dominant hydride synthesis mechanism by modifying the surface properties, reducing the particle size, controlling the surface oxidation or using additives. However, in our recent study we were able to experimentally demonstrate that different interface zone between substrate and film has significant effect on both film crystallinity and its reaction with hydrogen.

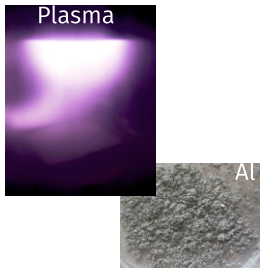
It was demonstrated that properties of the substrate-film interface zone can be changed either by using different substrate material or by using different substrate pre-treatment (for instance, substrate pre-treatment with varying plasma conditions).

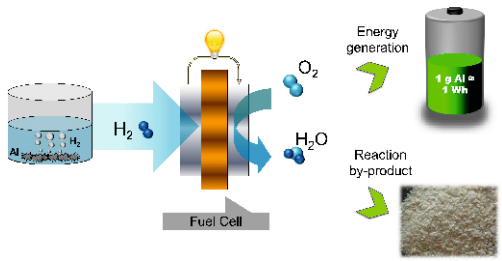


Hydrogen production using direct reaction between activated aluminum and water

Scientists at Lithuanian Energy Institute's Centre for Hydrogen Energy Technologies have developed a method of hydrogen production from water, using reaction between plasma activated Al and Mg metals (or their alloys) and water. The technology is patented WO2013151408. For instance, aluminum powder is activated under the low-temperature plasma treatment and immersed into the water.

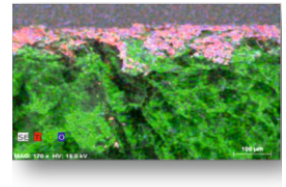
Reaction of activated aluminum with water yields about 1200 ml of hydrogen per gram of aluminum powder which can be supplied to the proton exchange membrane fuel cell generating about 1 Wh of electricity. In addition, obtained reaction by-product is suitable for the synthesis of the secondary pure product of gama-Al_2O_3 which can be used in the production of catalysts.



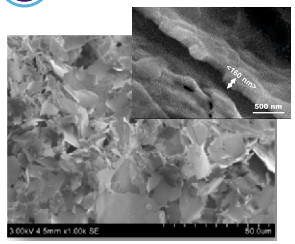


Functional coatings for polymers

A technology of oxide based functional thin films deposition on polystyrene grains and expanded polystyrene (EPS) foam sheet surfaces was developed at LEI CHET. Specific coatings can be used as antibacterial or antifungal layers, fire retardants, etc.



Nanoflake synthesis and testing



Using magnetron sputtering technique a special method of oxide and metal based nanocrystalline particles formation on soluble substrates we developed at CHET. After substrate dissolving and purification steps unique nanocrystalline nanoflakes are observed.

Centre facilities

Synthesis

- Magnetron sputtering and E-beam physical vapour deposition systems (Kurt.J.Lesker PVD-75)
- Planetary ball mill (Fritsch Pulverisette 6)

Analysis

- X-ray Photoelectron Spectrometer (PHI 5000 VersaProbe)
- Auger Electron Spectrometer (PHI 700Xi)
- X-ray diffractometer (Bruker D8) with environmental chamber for in-situ heating XRD
- Scanning Electron Microscope (Hitachi S-3400N)
- Energy-dispersive X-ray spectrometer (Bruker Quad 5040)
- Fully automated Sievert type instrument (Hy-Energy PCTPro-2000)
- Ionic-electric conductivity
- (impedance) tester (NorECs Norwegian Electro Ceramics AS Probostat)
- Glow discharge optical emission spectrometer (SPECTRUMA GDA 750)
- Nitrogen, Oxygen and Hydrogen quantity analyser (HORIBA EMGA-830)
- Dynamic Ultra-Hardness Tester (Shimadzu DUH-211S)
- Atomic Force Microscope (Microtestmachines NT-206)
- Double-beam spectrophotometer (JASCO V-656)
- Other supplementary equipment