PHYSICAL AND TECHNOLOGICAL SCIENCES

Laboratory of Metal-Organic Chemical Vapor Deposition

Keywords: *MOCVD technology, technology developments, oxides, thin films, heterostructures, characterisations, applications, microelectronics, opto-electronics, acusto-electronics*

Vilnius University

Research group activities

Functional oxide films and epitaxial heterostructures with combined different functionalities have a large potential for applications in various new devices of micro-, opto and acusto-electronics (e.g., solar cells, light emitting diodes, lasers, electrochromic devices, sensors, thin film transistors, radio-frequency (RF) devices as RF-resonators, filters, etc.). So, various oxide films/heterostructures are extensively investigated with a goal to improve the quality of films and functional parameters of devices, and to prepare cost-effective technologies for their production.

Our research group develops and optimises MOCVD process and equipment for the growth of films of transparent conducting oxides, mixed electronic-ionic conductors, coated conductors, dielectric, ferro-/piezo-electric, magnetoresistant, superconducting and other functional oxides with improved properties, including epitaxial multilayered heterostructures with new combined functionalities, for applications in micro-, opto-, acusto-electronics and other fields. Deposition process was elaborated for the grovth of various high quality films and multilayered heterostructures: on monocrystalline and metallic substrates, buffer layers films for phase-change memories, epitaxial heterostructures, superlattices.

Various metal-organic precursors used for MOCVD depositions were synthesized in our laboratory

Proposal

We offer:

- original technological developments and research-scale MOCVD equipment
- growth of various high quality oxide films
- synthesis of various metal-organic precursors for MOCVD depositions.

We seek:

Partners for developing competitive research projects targeting HORIZON 2020 and other international programs.

Meet our team

Lead researcher

Prof. Habil. Dr. **Adulfas Abrutis**

Staff

Assoc. prof. Dr. **Valentina Plausinaitiene**

Assoc. prof. Dr. **Virgaudas Kubilius**

Senior research fellow Dr. **Zita Saltyte**

Phd students

Sabina Kuprenaite

Tomas Murauskas

Milita Vagner

Research outcomes

125 papers were published in international journals with citation index, cited about 1300 times.

Selected important publications:

- **S. Kuprenaite**, **T. Murauskas, A. Abrutis, V. Kubilius, Z. Saltyte, V. Plausinaitiene**, Properties of In-, Ga-, and Al-doped ZnO films grown by aerosol-assisted MOCVD: Influence of deposition temperature, doping level and annealing. Surface and Coatings Technology, 271 (2015) 156-164.
- **Bartasyte, V. Plausinaitiene, A. Abrutis, T. Murauskas, P. Boulet, S. Margueron, J. Gleize, S. Robert, V. Kubilius, Z. Saltyte**. Residual stresses and clamped thermal expansion in LiNbO3 and LiTaO3 thin films. Applied Physics Letters, 101 (2012) 122902.
- **Abrutis, V. Plausinaitiene, M. Skapas, C. Wiemer, O. Salicio, A. Pirovano, E. Varesi, S. Rushworth, W. Gawelda, J. Siegel**. Hot-wire chemical vapor deposition of chalcogenide materials for phase change memory applications. Chemistry of Materials, 20 (2008) 3557-3559.

New technologies elaborated and developed:

- An original deposition technology - Pulsed Injection MOCVD (PI-MOCVD) - elaborated together with the French National Center for Scientific Research (CNRS). EU and US patent granted to CNRS, A.Abrutis is a co-author of the patents. This technology and research-scale reactors were implemented in universities and research centres in various countries. The technology was also applied in industrial MOCVD reactors (by Aixtron AG, Germany).
- An original deposition method combining PI-MOCVD and Hot-Wire CVD was elaborated and developed for deposition of oxide and non-oxide materials.
- A simple and cost-effective method of MOCVD depositions at atmospheric pressure was developed for oxide materials.

Laboratory participated in various European projects:

1) FP4 (COPERNICUS programme): Functional Thin Films Obtained By New MOCVD Techniques, 1997-2000,

2) FP5, MULTIMETOX: Metal Oxide Multilayers Obtained by Cost-Effective New CVD Technologies for Magnetoelectronic Microsystems and Nanotechnologies, 2000-2003,

3) FP5, CERMOX: Advanced Ultra-Thin Ceramic Membranes for Efficient Industrial Processes, 2001-2004,

4) FP6, CHEMAPH: Chemical Vapor Deposition of Chalcogenide Materials For Phase-Change Memories, 2006-2008.

Many other national and international projects were carried out. Collaboration with many international scientific and industrial partners has been established and developed.

Resources

Deposition facilities: Research-scale reactors - 3 low pressure PI-MOCVD reactors, 1 Hot-wire MOCVD reactor, 2 atmospheric pressure MOCVD reactors. Characterisation facilities: XRD, SEM, TEM, EDX, AFM and profilometry, UV-Vis-IR spectroscopy and fluorescence spectrometry, optical microscopy and elipsometry, thermal analysis (TGA, DTA, DSC), electrical (including Hall-effect) measurements, rapid thermal annealing, glove box for the work in an inert and dry atmosphere.

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