PHYSICAL AND TECHNOLOGICAL SCIENCES

Laboratory of Microwave Spectroscopy (LMS)

Keywords: *Dielectric spectroscopy (DS), ferroelectric and electromechanical testing (FEMT), electron paramagnetic spectroscopy (EPR)*

Vilnius University

Research group activities

- To develop new multifunctional ferroelectrically, piezoelectrically and magnetically active materials for innovative sensors and actuators.
- To create effective coating materials to shield to electromagnetic radiation.

Emerging new requirements for future devices drive the research of smart and preferably multifunctional materials. This stimulates material scientists to find new attractive properties of the synthesized materials for innovative applications. Broadband dielectric spectroscopy in conjunction with the ultrasonic and electron paramagnetic resonance (EPR) spectroscopy available in the LMS can reveal both macroscopic and microscopic behavior of these materials and provide valuable knowledge of their applicability.

The research focuses on the tunable multiferroic materials attractive for various kinds of sensors and/or actuators, carbon-based nanocoatings perspective for electromagnetic shielding applications and new kind of nanoelectronics, composites and hybrid organic-inorganic materials, which have the possibility to combine various physically different properties in the same material and even induce the coupling between them leading to various multifunctionalities.

Proposal

Investigation of dielectric properties of any nanostructured or bulk materials in a broad frequency range as possible.

- Broadband dielectric and/or impedance spectroscopy of bulk (10 μ – 120 GHz) and thin film (20 Hz – 50 GHz) materials in a wide temperature region.
- Infrared studies of dielectric properties of bulk and thin film samples in 10 cm^{-1} – 25000 cm^{-1} range.
- Dielectric spectroscopy of liquids in 10 MHz – 40 GHz frequency range.
- Continuous-wave and pulse EPR spectroscopy.
- Ultrasonic, ferroelectric, piezoelectric characterization and tunability measurements of bulk and thin film samples.

The group is seeking for partnership with material scientists, theorists and engineers to characterize new materials, develop new measurement techniques, verify new ideas, and work on proof-of-concept devices and structures based on (but not limited to) ferroelectrics, piezoelectrics, polymers, composites, liquids and other multifunctional materials.

Meet our team

Lead researcher

The leader of LMS is Prof. Habil. Dr. Jūras Banys. He is the co-author of more than 400 publications and several chapters in monographs. Over 20 years of research experience Prof. J. Banys gathered deep knowledge of ferroelectrically, piezoelectrically and magnetically active materials. He is an expert in several experimental techniques: broadband dielectric spectroscopy, X-ray diffraction, Infrared and Raman spectroscopies, nuclear magnetic and electron paramagnetic resonance techniques. Prof. J. Banys have a wide group of collaborators in Oxford, Leipzig, Lausanne, Prague, Wroclaw, Yamanashi and other universities.

Group members

Senior researcher Dr. **Jan Macutkevic**

Dr. **Saulius Lapinskas**

Prof. Dr. **Robertas Grigalaitis**

Assoc. Prof. Dr. **Maksim Ivanov**

Dr. **Andrius Džiaugys**

Dr. **Saulius Rudys**

Dr. **Martynas Kinka**

Dr. **Vidmantas Kalendra**

Dr. **Edita Palaimienė**

PhD students

Sergejus Balčiūnas

Džiugas Jablonskas

Ieva Kranauskaitė

Šarūnas Svirskas

Mantas Šimėnas

Ilona Zamaraitė

Research outcomes

Most important publications

The group of LMS is actively publishing the obtained scientific results in high level international journals including NANO LETTERS, PHYSICAL REVIEW, JOURNAL OF PHYSICAL CHEMISTRY C, PHYSICAL CHEMISTRY CHEMICAL PHYSICS, APPLIED PHYSICS LETTERS, and many others. To date there is more than 400 papers published by the group members. Listed below are selected highly cited papers:

- **I.Anusca, S.Balčiūnas, P.Gemeiner, S.Svirskas, M.Sanlialp, G.Lackner, C.Fettkenhauer, J.Belovickis, V.Samulionis, M.Ivanov, B.Dkhil, J.Banys, V.V.Shvartsman, D.C.Lupascu,** „Dielectric Response: Answer to Many Questions in the Methylammonium Lead Halide Solar Cell Absorbers," Advanced Energy Materials, 1700600, DOI: 10.1002/aenm.201700600 (2017).
- **J. Macutkevic, S. Kamba, J. Banys, A. Brilingas, A. Pashkin, J. Petzelt, K. Bormanis and A. Sternberg**, "Infrared and broadband dielectric spectroscopy of PZN-PMN-PSN relaxor ferroelectrics: Origin of two-component relaxation," Phys. Rev. B 74, 104106 (2006).
- **M.Simenas, A.Ciupa, M.Maczka, A.Poeppl, J.Banys**, „EPR study of structural phase transition in manganese doped [(CH3)2NH2][Zn(HCOO)3] metal – organic framework," Journal of Physical Chemistry C, 119, 43, 24522-24528 (2015).
- **J.Banys, J.Macutkevic, R.Grigalaitis and W.Kleemann**, "Dynamics of nanoscale polar regions and critical behavior of the uniaxial relaxor Sr0.61Ba0.39Nb2O6:Co," Phys.Rev.B, 72, 024106 (2005).

Resources

Dielectric characterization:

Solartron 1250 analyzer (10μHz-60kHz),HP 4284A LCR meter (20Hz-1MHz), Agilent 8714ET (300kHz-3GHz) and E8363B (10MHz-40GHz) vector network analyzers, Elmika 2400 scalar analyzers (8-12, 27-40, 35-55GHz), Teravil time-domain THz spectrometer (0.1-3THz),

Bruker Vertex 80V FTIR spectrometer (10-25000 cm^{-1});

Ferroelectric and electromechanical characterization:

aixACCT TF 2000 analyzer with single beam laser interferometer, high-voltage supply up to 4 kV.

Contacts

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More about the faculty: http://ff.vu.lt/en