PHYSICAL AND TECHNOLOGICAL SCIENCES

Group of photoelectric phenomena research

Vilnius University

Keywords: *photo-ionization spectroscopy (PPIS); photoconductivity&carrier trapping transients (MW-PC); luminescence spectroscopy (LS); hadron induced MW-PC&LS; DLTS; spectroscopy of radiation defects; dosimetry; Si, GaN, diamond materials*

Research group activities

Technologies and instrumentation for contactless-remote spectroscopy and dosimetry of fluences of high energy radiations are important for modern accelerator facilities, medical diagnostics, monitoring of radiation safety by using new generation sensors and scanners. The radiation-hard fast-response radiation sensors made of GaN & diamond materials are promising in design and fabrication of the new generation radiation detectors. Development and composite application of different techniques such as PPIS, MW-PC, HILS, TDCT-MWPC-S, O-DLTS and other methods are important for comprehensive characterization of materials and device structures during implementation of these objectives.

Our research is focused on:

- Technologies and instrumentation for spectroscopy and contactless-remote dosimetry of the large fluences of high energy radiations;
- Solar-blind radiation-hard fast-response sensors made of GaN & diamond materials;
- Search of radiation hard materials and development of radiation tolerant structures;
- Engineering of radiation defects and radiation technologies for production of electronic devices;
- Radiation nanoclusters within nanotechnology;
- Technologies and instruments for the remote in situ measurements in harsh irradiation environments;
- Design and fabrication of instruments for spectroscopy of technological and radiation defects in materials of electronic and optoelectronic industry;
- Development of advanced material characterization techniques and instruments;
- Engineering of defects is an important field in modifying high power and high speed semiconductor devices as well as in development of radiation hard particle and photo sensors capable to operate in cosmic space and modern particle accelerators;
- Technologies and instrumentation for spectroscopy of high energy radiations are also important for medical diagnostics and monitoring of radiation safety within nuclear power plants and storage facilities of radioactive waste.

Proposal

We offer material and device characterization services in semiconductors of various technologies: Si, Ge, Si-Ge, GaAs, GaN, CdS, ZnSe, diamond, etc.; organic and polymeric materials (such as alanine, PEN); solar cells, LEDs, power PIN diodes and thyristors, particle detectors by using:

- microwave absorption and reflection transient techniques;
- infrared absorption transient techniques;
- capacitance, current and optical deep level transient spectroscopy (C-,I-,O-DLTS);
- electron paramagnetic resonance (EPR) spectroscopy;
- infrared spectroscopy (IRS) of vibrational modes;
- small harmonic test signal and pulsed capacitance spectroscopy (LRC/BELIV);
- pulsed photo-ionisation spectroscopy (PPIS);
- in situ analysis of evolution of radiation defects;
- lateral and cross-sectional scans of defect distribution;
- pulsed photo-ionisation and capacitance spectroscopy;
- profiling of injected charge drift current transients;
- combined in situ analysis of evolution of luminescence and photoconductivity during irradiation by various high energy particles.

Meet our team

Leader researcher: Prof. Habil. Dr. **Eugenijus Gaubas**

Research staff: Prof. Habil. Dr. **Juozas Vidmantis Vaitkus**, Prof. Habil. Dr. **Vaidotas Kažukauskas**, Dr. **Tomas Čeponis**, Dr. **Jevgenij Pavlov**, Dr. **Vytautas Rumbauskas**, Dr. **Algirdas Mekys**, Dr. **Ernestas Žąsinas**, **Laimonas Deveikis**, **Kornelijus Pūkas**

PhD student: **Dovilė Meškauskaitė**

Research outcomes

Most important publications

- **E. Gaubas, T. Ceponis, V. Kalesinskas**, Currents induced by injected charge in junction detectors, Sensors 13 (2013) 12295-12328.
- **E. Gaubas, T. Čeponis, J. V. Vaitkus** „Pulsed capacitance technique for evaluation of barrier structures“, LAMBERT Academic Publishing, Saarbrucken-Berlin, 2013, ISBN: 978-3-659-50518-8.
- **E. Gaubas, T. Ceponis, J. Pavlov, and A. Baskevicius**. „Profiling of the injected charge drift current transients by cross-sectional scanning technique“ J. Appl. Phys. 115, 054509 (2014).
- **E. Gaubas, T. Ceponis, A. Jasiunas, V. Kovalevskij, D. Meskauskaite, J. Pavlov, V. Remeikis, A. Tekorius, and J. Vaitkus**, „Correlative analysis of the in situ changes of carrier decay and proton induced photoluminescence characteristics in chemical vapor deposition grown GaN“ Appl. Phys. Lett.104, 062104 (2014).
- **E. Gaubas, E. Simoen, J. Vanhellemont** „Review—Carrier lifetime spectroscopy for defect characterization in semiconductor materials and devices“, ECS Journal of Solid State Science and Technology, 5 (4) P3108-P3137 (2016).
- **E. Gaubas** et al, Study of neutron irradiated structures of ammonothermal GaN, J. Phys. Appl. Phys. 50 (2017) 135102.
- **E. Gaubas, T. Ceponis, D. Meskauskas, J. Pavlov, A. Zukauskas, V. Kovalevskij, V. Remeikis**, In situ characterization of radiation sensors based on GaN LED structure by pulsed capacitance technique and luminescence spectroscopy, Sens. & Act. A 267 (2017) 194–199.

Most important international projects

- H2020 project AIDA-II “Advanced European Infrastructures for Detectors at Accelerators”.
- CERN RD39 Collaboration program “Cryogenic Tracking Detectors”.
- CERN RD50 Collaboration program “Radiation Hard Semiconductor Devices for Very High Luminosity Colliders”.
- Bilateral IMEC–Vilnius University collaboration on „Characterization of advanced materials for nano-electronics“.

Contacts

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