2005

International projects

- **"The New Technology of Roll Production"** (2005‑2006), EURECA project E!3444-EULASNET-ULCOP

Project tasks: investigation of morphology, composition and microstructure of WCCo coverings of steelrolls; the analysis of dependence of the WCCo coverings properties on powder particle size, chemical composition and conditions of synthesis; determination of the influence of steel substrate pretreatment, technological conditions of the covering process and thickness of the coverings on the quality of WCCo layers; evaluation of the state of WCCo covered steel rolls exploited under various conditions; surface analysis of the WCCo covered rolls tested in real conditions of metallurgy enterprise.

- **"Imprinting of Ordered Organic Nanofibers"** (2005‑2006), NEXUS project

The project was carried out together with South Denmark University.

Design and production of master matrix was performed. Hot embossing and microtransfer technology was employed for the imprinting of ordered organic nanofibers. The advanced surface analysis facilities were employed to control geometry and quality of nanofibers.

National projects

- **"Fluctuation Spectroscopy of New Generation Nanometer Scale Ducts with 2D Electron Gas" (FLIUKTUACIJOS)** (2005‑2006), priority areas of Lithuanian research and experimental development program project

The project was carried out together with PFI, VU, VU TFAI.

Project purpose: to expand the application field of original fluctuation methods created in Semiconductor Physics Institute and Noise Research Laboratory of Vilnius University by investigating ultra-fast kinetic processes and fluctuations in new generation nanoobjects made of strained silicon, strained silicon-germanium, gallium arsenide, indium phosphide, gallium nitride and similar semiconductors. Objective – to participate in development of the fundamental physics of ultra-fast electronics and optoelectronics on an international level, thus influencing the development of high-tech in Lithuania and the world. The participation of the researchers from Physical Electronics Institute of Kaunas University of Technology in the project enabled to successfully solve technological problems: the researchers of this institute have experience with A3B5 semiconductors and the formation of Schottky and ohmic contact formation and surface preparation (ion beam and chalcogenide solutions). During the project, the qualification of theoretical scientists from Theoretical Physics and Astronomy Institute of Vilnius University was used.

Objective of the research ‑ advancement of fluctuation spectroscopy for fast and ultra-fast electronic processes and its application for investigating new generation derivatives, meant for fast silicon and A3B5 compound electronics and optoelectronics. Fluctuation methods, which were created earlier and authorised for investigation of AlGaN/AlN/GaN, AlGaN/GaN derivatives, were improved by applying for investigation of microwave range field effect transistors, including non-destructive investigation of the properties of the derivatives (on-wafer characterization). Most attention was given for strained nanometer wide silicon ducts, squeezed between SiO_2 layers (SiO_2/Si/SiO_2), strained (pseudomorphous) Si/Ge ducts, adjusted and pseudomorphous A3B5 compound ducts with 2D electron gas, etc. Unique pulsed microwave range electronic noise measurement method was employed for hot electron energy

relaxation time, hot photon decay time dependence from electric power and technology of manufacturing. Theoretical methods for ultra-fast kinetic processes, their relaxation times and fluctuation spectrum dependencies investigation were developed. Theoretical evaluation of electron mutation influence on the fluctuation phenomena in 2D electron gas was performed. Employing a unique low frequency noise characteristics measurement method, new composition ultra-fast optoelectronics devices (GaInAsP/InP, GaAs/AlGaAs and GaN laser and light diodes with nanoderivatives, InGaAs avalanche and p-i-n photodiodes) noise characteristics were investigated, their connection with aforementioned device composition, manufacturing technology, quality and longevity were evaluated. In cooperation with manufacturers, factors influencing the characteristics of the performance and longevity of these devices were evaluated as well as opportunities to improve their composition and manufacturing technology. Both theoretical and experimental investigations were performed for fast semiconductor lasers with quantum derivatives dynamic, pulse and frequency characteristics, the parameters of charge carriers and photon parameters were evaluated in the laser working area.

- **"Improvement and Installation of New Microrelief Formation Technologies" (MINATECH)** (2005‑2006), high-tech development program project

The project was carried out together with KTU, VU, FI, JSC Ekranas, JSC Lodvila.

The project was designed to improve the processes of lithography, to create new and efficient micro and nanorelief forming technologies (optical holography, thermal imprint and nanoimprint lithography), to apply them in the manufacturing process of optical instruments (anti-counterfeiting marks for documents and goods) and to create next generation functional elements of organic nanoelectronics and nanooptoelectronics (photonic crystal, plane waveguide structures, field effect transistors). The project aimed to unite the efforts of science, studies institutions and high-tech industry as well as the user and installer of high-tech products (JSC Lodvila) in research and installation of new technologies.

The outcome of the project was a new smart anti-counterfeiting technology created for protection of documents and goods, which was installed by JSC Lodvila (press company, which has the license to print documents of securities), the technological documentation of production and control of holograms was also prepared. The new technologies were applied for the formation of a photonic waveguide device prototype (passive optical filter with dispersion compensator for 1.5 mm wavelength); a photonic plasmonic waveguide device prototype (passive optical filter and plasmonic waveguide 2‑12 mm wavelength spectrum), a field effect transistor prototype (using unique materials)