## 2015 m.

### International projects

- **"The Electronic and Plasmonic Properties of Chemical Vapour Deposited Graphene Nanostructures"** (2015‑2016), funded by Research Council of Lithuania, in the framework of Lithuania and Belarus bilateral cooperation

The purpose of the project is to determine the interrelations of structural, electronic and plasmonic properties of graphene formed by chemical vapour deposition technique and their applications for new information transfer and treatment elements.

The objectives of the project: to optimise the chemical vapour deposition technique of graphene; to develop and optimise the technique of graphene transport from a metal catalyst substrate on the other surfaces; to determine the structure of chemical vapour deposited and transported graphene; to build up a technique of metal and metal contacts formation on graphene surface; to theoretically and experimentally investigate the effects of metal/graphene heterostructures; to create the technology of graphene nanostructures formation; to form chemical vapour deposited graphene nanostructures; to investigate their structural and electronic properties in a temperature range from 4 to 300 K; to make the theoretical model of plasmonic properties of graphene nanostructures and to carry out measurements of plasmonic properties in sub-terahertz range.

*Publications*:

• Čiegis, Arvydas; Vasiliauskas, Andrius; Meškinis, Šarūnas; Tamulevičius, Sigitas. UV irradiation effects on DLC:Ag films: charging of the plasmonic nanoparticles // Physics, chemistry and applications of nanostructures: proceedings of international conference nanomeeting - 2015: Minsk, Belarus, May 26-29, 2015: reviews and short notes. New Jersey: World Scientific Publishing, 2015, ISBN 9789814696517. p. 77-79.

• Meškinis, Šarūnas; Tamulevičius, Sigitas. Diamond-like carbon based silver nanocomposites – short review of the technology and novel applications // Physics, chemistry and applications of nanostructures: proceedings of international conference nanomeeting - 2015: Minsk, Belarus, May 26-29, 2015: reviews and short notes. New Jersey: World Scientific Publishing, 2015, ISBN 9789814696517. p. 319-325.

• Komissarov, I. V., Kovalchuk, N. G., Labunov, V. A., Girela, K. V., Prischepa, S. L., Korolik, O. V., Tivanov, M. S., Lazauskas, A., Andrulevičius, M., Tamulevičius, T., Grigaliūnas, V., Meškinis, Š., Tamulevičius, S. Micro-Raman studies of nitrogen doped twisted graphene grown by atmospheric pressure CVD on copper from decane precursor//Carbon. (Submitted, 03.2016)

- **"Plasmonic Properties of Silver Nanoparticles and Self- Assembled Clusters" (PLAS)** (2015‑2017), funded by Research Council of Lithuania, in the framework of Lithuanian‑Japan Cooperation Programme

The purpose of the project is detailed analysis of ultrafast energy relaxation phenomena in plasmonic nanostructures, demonstrating photo-catalytic activity. Multi-faced silver nanoparticles will be arranged and manipulated into large-area clusters employing capillary force assisted deposition from colloidal solutions and using nanomasks. Masks with nanometres resolution will be fabricated using electronic and "soft" nanolithographies. Ultrafast differential absorption spectroscopy will be used for investigation of photocatalytic properties of nanostructures and ultrafast energy relaxation processes along with their dependencies on the size, shape and arrangement of nanoparticles. Heating experiments of nanoparticles

will be performed and their effect on energy relaxation processes will be investigated, considering absorption of nanoparticles clusters and chosen parameters of laser influence. Tasks of the project: synthesis of different configuration of Ag nanoparticles as well as Ag- $TiO_2$ nanostructures; characterization of nanoparticles including morphology, shape, crystallinity, chemical composition and particle size distribution; production of two dimensional nanostructures employing capillary assisted deposition and lithographically nanostructured templates; studies of energy relaxation processes in the nanoparticles of complicated shape and two-dimensional nanostructures employing pump-probe spectroscopy; analysis of femtosecond laser irradiation modified silver nanoparticles and two-dimensional nanostructures. During the project, capillary assisted deposition method will be developed and employed for fabrication of two-dimensional nanostructures and further applications in photo-catalysis and surface enhanced Raman scattering spectroscopy. It is expected that poly-faced Ag nanoparticles of different shapes, fabricated in the laboratory of project partners, will increase photocatalytic efficiency and $TiO_2$ absorbance will be extended into ultraviolet and near-infrared regions, because of Ag nanoparticles influence.

*Publications*:

• D. Virganavičius, M. Juodėnas, T. Tamulevičius, H. Shift, S. Tamulevičius // Investigation of Transient Dynamics of Capillary Assisted Particle Assembly Yield // Applied surface science, Volume 406, 1 June 2017, Pages 136–143, doi: 10.1016/j.apsusc.2017.02.100

• M. Juodėnas, T. Tamulevičius, O. Ulčinas, S. Tamulevičius // Implementation of an Optimized Microfluidic Mixer in Alumina employing Femtosecond Laser Ablation // Journal of Micromechanics and Microengineering (Available online 8 August 2017), doi: 10.1088/1361-6439/aa84fc

• D. Peckus, H. Rong, L. Stankevicius, M. Juodenas, S. Tamulevicius, T. Tamulevičius, J. Henzie //Hot Electron Emission Can Lead to Damping of Optomechanical Modes in Core-Shell Ag@TiO2 Nanocubes // Journal of Physical Chemistry C (Available online 6 October 2017), doi: 10.1021/acs.jpcc.7b06667

- **"Baltic Infrastructure for Research, Technology and Innovation" (BIRTI Platform)** (2015‑2016), Action Plan for the EU Strategy for the Baltic Sea Region "Seed Money Facility" project.

The purpose of the project is to create an innovative environment for materials science development in the Baltic Sea region, creating direct added value to enterprises and innovation development of the region as a whole. BIRTI platform focuses on three priority directions: 1) a unified platform for scientific equipment with easy-understandable content; 2) R&D enterprises; 3) the possibility of platform participants to acquire new knowledge of materials science. All these activities are focused on the efficient use of equipment, R&D activities in the Baltic Sea region, by increasing the industrial competitiveness in international market. The project is designed for targeted marketing activities, working with the industry and explaining the benefits of cooperation with research institutions, creating interest of enterprises in cooperation with scientific institutions.

- **"Electrochemical Processing Methodologies and Corrosion Protection for Miniaturization of Devices and Systems" (e-MINDS)** (2015‑2019), COST MP1407 project in collaboration with Vilnius University.

The main research topics involve the development of electroplating technology and application of the galvanization processes.

- **"Power Electronics for Green Energy Efficiency" (Green PE),** (2015‑2019), INTERREG Baltic Sea region project No #R019.

Project leader University of Southern Denmark.

Project leader at KTU Prof Habil Dr Sigitas Tamulevičius.

The project involves widely BSR companies in the development of a technology and product roadmap enabling them to define their technology and business strategies (e.g., adequate technology, timing of investments). The project carries out three demonstration pilots in the market sectors renewable energies, e-mobility and smart buildings with 8 companies and 7 research institutions. In addition, the research partners consult 14 BSR companies supporting their R&I strategy development. All project results will be spread across the BSR via dedicated technology marketing measures, thus advancing the BSR capacities in the enabling technology (http://balticgreenpower.eu/).

## National projects

- **"Nanolithography for Ultraviolet Optics" (UVDIODE)** (2015‑2017), funded by Research Council of Lithuania

The aim of the project is creation of a manufacturing technology of polymer micro lenses array for InAlGaN UV LEDs in order to enhance the spatial resolution and the beam power density. Advanced nanolithography techniques (3D e-beam nanolithography, thermal reflow and deep RIE) are used to create a 3D fused silica mould of micro lenses. A 3D mould is used for the cheap replication of micro lenses in the UV transparent fluoropolymers using the UV nanoimprint lithography technique. The resistance of micro lenses to environmental conditions, UV light as well as to mechanical impact is going to be investigated.

*Publications*:

- Grigaliūnas, Viktoras; Jucius, Dalius; Lazauskas, Algirdas; Andrulevičius, Mindaugas; Sakaliūnienė, Jolita; Abakevičienė, Brigita; Kopustinskas, Vitoldas; Smetona, Saulius; Tamulevičius, Sigitas. Effects of 3D microlens transfer into fused silica substrate by CF4/O2 dry etching // Applied surface science. Amsterdam: Elsevier. ISSN 0169-4332. 2017, vol. 393, p. 287-293. [Science Citation Index Expanded (Web of Science); Current Contents (Physical, Chemical & Earth Sciences); Current Contents (Engineering, Computing & Technology); Science Direct]. [IF: 3,150, AIF: 3,592 (E, 2015)].
- Grigaliūnas, Viktoras; Lazauskas, Algirdas; Jucius, Dalius; Viržonis, Darius; Abakevičienė, Brigita; Smetona, Saulius; Tamulevičius, Sigitas. Microlens fabrication by 3D electron beam lithography combined with thermal reflow technique // Microelectronic engineering. Amsterdam: Elsevier. ISSN 0167-9317. 2016, vol. 164, p. 23-29. [Science Citation Index Expanded (Web of Science); Science Direct; Compendex; Inspec; Chemical Abstracts (CAplus); Academic Search Alumni Edition; Academic Search Complete; Academic Search Elite; Academic Search Premier; Academic Search Research & Development; Ingenta Connect]. [IF: 1,277, AIF: 3,220 (E, 2015)].

- Jucius, Dalius; Kopustinskas, Vitoldas; Grigaliūnas, Viktoras; Guobienė, Asta; Lazauskas, Algirdas; Andrulevičius, Mindaugas. Highly hydrophilic poly (ethylene terephthalate) films prepared by combined hot embossing and plasma treatment techniques // Applied surface science. Amsterdam: Elsevier. ISSN 0169-4332. 2015, vol. 349, p. 200-210. [Science Citation Index Expanded (Web of Science); Science Direct]. [IF: 3,150, AIF: 3,592 (E, 2015)].
- Grigaliūnas, Viktoras; Lazauskas, Algirdas; Jucius, Dalius; Viržonis, Darius; Abakevičienė, Brigita; Smetona, Saulius; Tamulevičius, Sigitas. Microlens fabrication by 3D electron beam lithography combined with thermal reflow technique // Microelectronic engineering. Amsterdam: Elsevier. ISSN 0167-9317. 2016, vol. 164, p. 23-29. [Science Citation Index Expanded (Web of Science); Scopus; Compendex; Inspec; Chemical Abstracts (CAplus); Academic Search Alumni Edition; Academic Search Complete; Academic Search Elite; Academic Search Premier; Academic Search Research & Development] [M.kr. 08T]. [Indėlis: 0,143]. [IF (E): 1,806 (2016)
- Grigaliūnas, Viktoras; Jucius, Dalius; Lazauskas, Algirdas; Andrulevičius, Mindaugas; Sakaliūnienė, Jolita; Abakevičienė, Brigita; Kopustinskas, Vitoldas; Smetona, Saulius; Tamulevičius, Sigitas. Effects of 3D microlens transfer into fused silica substrate by CF4/O2 dry etching // Applied surface science. Amsterdam: Elsevier. ISSN 0169-4332. 2017, vol. 393, p. 287-293. [Science Citation Index Expanded (Web of Science); Scopus; Current Contents/Physical, Chemical & Earth Sciences; Current Contents/Engineering, Computing & Technology] [M.kr. 08T]. [Indėlis: 0,111]. [IF (E): 3,387 (2016)]
- Jucius, Dalius; Grigaliūnas, Viktoras; Lazauskas, Algirdas; Sapeliauskas, Evaldas; Abakevičienė, Brigita; Smetona, Saulius; Tamulevičius, Sigitas. Effect of fused silica surface wettability on thermal reflow of polymer microlens arrays // Microsystem technologies. Berlin: Springer. ISSN 0946-7076. 2017, vol. 23, iss. 6, p. 2193-2206. [Science Citation Index Expanded (Web of Science); Scopus; SpringerLINK] [M.kr. 08T]. [Indėlis: 0,143]. [IF (E): 1,195 (2016)]

## Self-supporting projects

- **"Investigation of Material and Properties of the Polypropylene Product (chair)"** (2015), JSC Vaigora

JSC Vaigora believes plastic waste to be sore ecological problem, because of its high resistance to decomposition, and decided to make a research to help more precisely determine the amount of recycled polypropylene, which could be used in production. The company aims to contribute to sustainable development and effective use of resources. One of the main problems of polypropylene products, such as chairs, used in sports and leisure activities, is material resistance to shock and UV radiation. JSC Vaigora makes benches, tribunes, tables for referees in various implementing projects, where plastic polypropylene chairs are needed. The company faces problems of colour fading of chair, because of UV radiation, and rupture of chair construction in case of load or if too big amount of recycled polypropylene was used in the production. During the project, the following goals were solved: polypropylene Mosten GB 506 chair was investigated using physical and chemical analysis methods; physical and chemical properties of polypropylene Mosten GB 506 chair and analogue chair were compared; properties of the product with increasing content of recycled polypropylene were investigated.

- **"Transducer of Heat Energy to Electricity"** (2015), JSC Julsena

By fulfilling of MITA innovation check funded JSC Julsena order, a working prototype – source of alternative energy – was developed and constructed. It had the following properties:

- Heat energy to electricity conversion based working principle

- Prototype dimensions: 85.6 mm x 53.9 mm. Thickness of the slide is not critical

- Generated electricity parameters: electromotive force ≥2 V; voltage ≥0.8 V (load 1 kΩ)

- **"Timber and Chemical Materials Studies by Physical and Chemical Analysis Methods"** (2015), JSC Grigo

The comparison of an oak timber characteristics was carried out (natural 6,000 years old swamp oak and artificially aged oak) in order to improve the technological processes of oak wood treatment. Timber sample research: X-ray photoelectron spectroscopy (XPS), infrared spectroscopy (FTIR), optical spectroscopy (UV-VIS), X-ray diffraction (XRD), atomic absorption spectroscopy (AAS) methods. Chemical materials were investigated by optical spectroscopy (UV-VIS) and atomic absorption (AAS) methods.

- **"Investigation of the Resistance of the Indicator part of the Digital Electricity Meter Polycarbonate in Case of Sun Radiation"** (2015), JSC Elgama-Elektronika

The changes of the indicator part of the polycarbonate case transmissivity for 172-1100 nm range before and after exposure to a simulated solar spectrum were investigated. Using FTIR spectroscopy, vibration spectra of polycarbonate were registered before and after the test procedures and an analysis of functional molecular groups was carried out.