Проект 7РП “BELERA” как инструмент развития научного отенциала Белорусского государственного университета информатики и радиоэлектроники в области углеродных нанотрубок и фотоники

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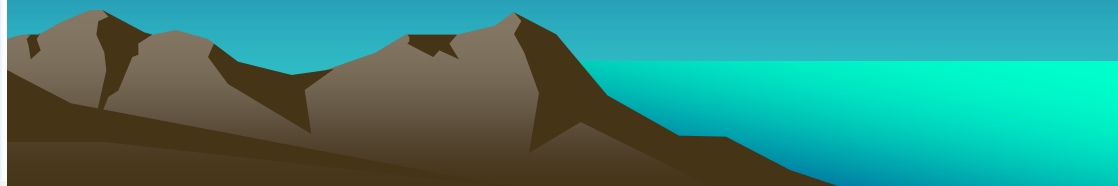
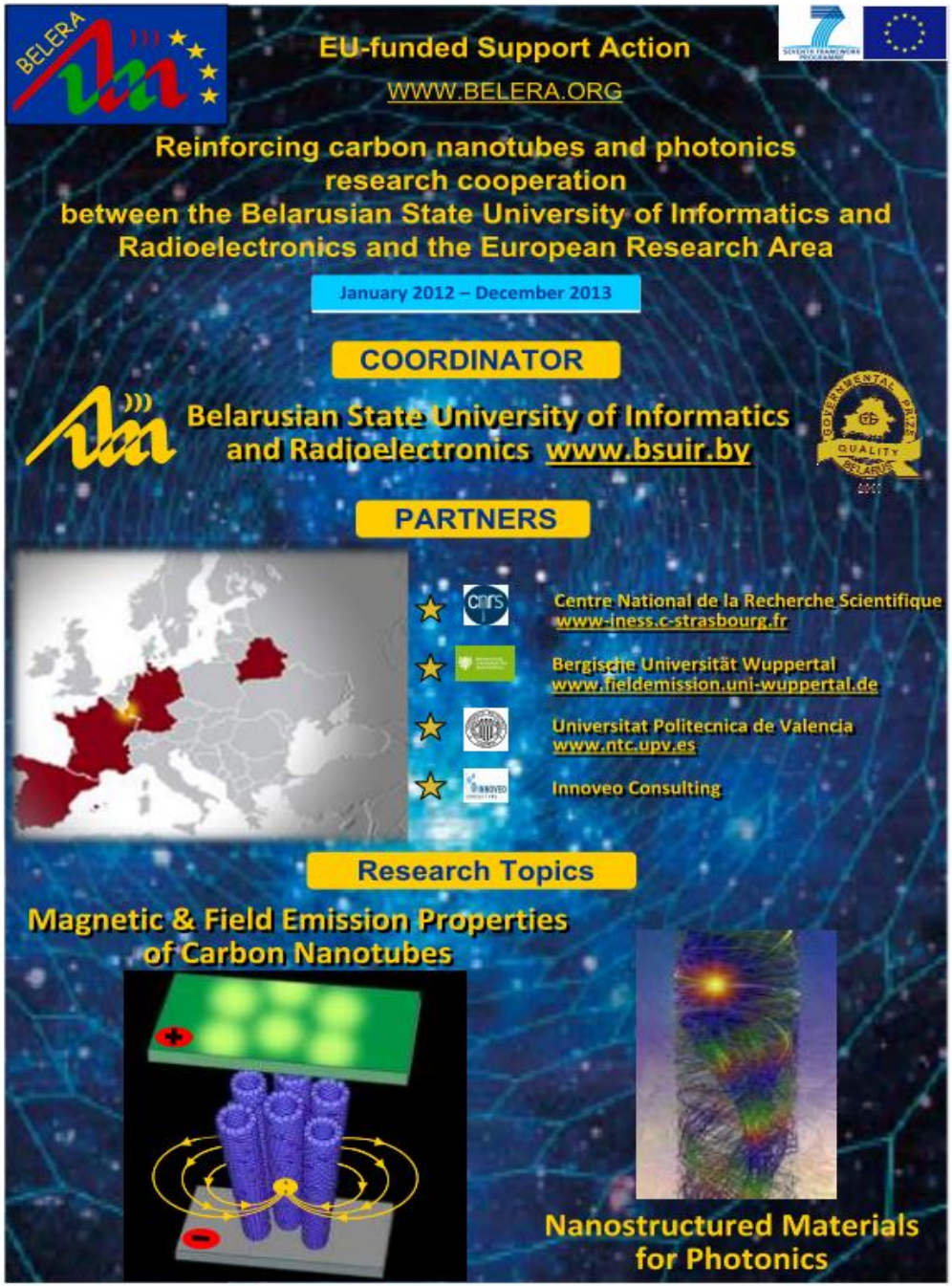
SEVENTH FRAMEWORK PROGRAMME




BELERA
EU-funded Support Action
WWW.BELERA.ORG
Reinforcing carbon nanotubes and photonics research cooperation between the Belarusian State University of Informatics and Radioelectronics and the European Research Area
January 2012 – December 2013
COORDINATOR
Belarusian State University of Informatics and Radioelectronics www.bsuir.by
PARTNERS
Centre National de la Recherche Scientifique www-iness.c-strasbourg.fr
Bergische Universität Wuppertal www.fieldemission.uni-wuppertal.de
Universitat Politecnica de Valencia www.ntc.upv.es
Innoveo Consulting
Research Topics
Magnetic & Field Emission Properties of Carbon Nanotubes
Nanostructured Materials for Photonics

Poster

Executive Summary

- *The work carried out during the 1st Semester has been devoted to:*
- **Twinning** activities with respect to the Research topics A, B and C, including setting joint experiments, preparing scientific papers, reporting the joint research work results at the international scientific conferences;
- **Dissemination and promotion** of the FP7 BELERA Project and BSUIR by means of creation of the BELERA web-site, designing and producing promotional material (Project leaflet, poster, and brochure about BSUIR); promoting BELERA and FP7 during workshops and conferences.
- All the deliverables were made in time in close cooperation with all project partners. The activities concerning training development and strategy development will be fulfilled in the next semesters.

WP1. Project Management

- In the WP1 *BSUIR* has spent efforts on the following activities:
- **Task 1.1** Over all coordination of the project
- Discussions of the tasks/issues with the members of Magnetism (Topic A), Field-emission (Topic B) and Nanostructured Materials for Photonics (Topic C) groups of BSUIR;
- Preparation and submission of Management and Quality Plan (D1.1)
- **Task 1.2** Project Meetings
- Organization of the Keek-off Meeting in Minsk, Belarus (1-2 of March, 2012) on which the detailed project planning/work allocation was performed;
- Participation of Prof. V. Labunov and Y. Tamashevich in the Meeting in Wuppertal, Germany (4th of May, 2012) devoted to discussions of the further project's tasks and activities.
- **Task 1.3** Produce progress/Final Reports - made Progress, Monitor Expenses and Publicity Reports for 6-months period, as well as the Synthetic Activity Report covering M1-M6 (D1.2)

WP2. Twinning

- In the WP2 *BSUIR* has spent efforts on the following activities:
- **Task 2.1** Twin with CNRS-InESS with respect to Research Topic A
- The work performed in collaboration with CNRS-InESS has been focused on investigation of structural and magnetic properties of carbon nanotubes (CNTs) with ferromagnetic inclusions.
- At first, CNT samples were synthesized by chemical vapour deposition (BSUIR). Then, the CNT samples were analysed by scanning electron microscopy, X-ray photoemission spectroscopy and Raman Spectroscopy (CNRS-InESS). Based on the CNT material analysis, a theoretical model was developed in order to explain the obtained experimentally microwave characteristics of CNT samples (BSUIR). In particular, such parameters as magnetic and dielectric properties of both the carbon nanotube medium and nanoparticles, the volume concentration and the dimensions of the nanoparticles, the wave impedance of the resistive capacitive shells of the conductive nanoparticles are taken into account in the developed theoretical model. Moreover, the frequency dependencies of permittivity and permeability of the studied nanocomposite were also obtained.

WP2. Twinning
(continuation)

- As a result of this work, a joint article was prepared, submitted and just published in the high-rank scientific journal **(J. Appl. Phys. 112, 024302 (2012); doi: 10.1063/1.4737119).**
- Currently, we have jointly started a new study devoted to a complex investigation of the structural/magnetic properties of CNTs with magnetic inclusions depending on various synthesis conditions (temperature, carrier-gas frlow, catalyst precursor concentration).
- For this, a set of CNT samples were synthesized at different synthesis conditions (BSUIR). The analysis of these samples with such techniques as X-ray photoemission spectroscopy, Raman Spectroscopy, scanning and transmission electron microscopies, X-ray Diffraction, and SQUID magnetometer is being performed (CNRS-InESS).
- In order to realize the aforementioned, two trips of BSUIR team members of Research topics A to CNRS-InESS were made (14-23 of May 2012 – 2 persons, 18-30 of June 2012 – 1 person).
- 3 persons participated in the International Scientific Conference entitled “Fundamental and Applied NanoElectroMagnetics” (FANEM’12) held in Belarusian State University, Minsk, Belarus, May 22-25, 2012 under EU FP7 Project № 266529 BY-NanoERA (http://nano.bsu.by/fanem12/).

WP2. Twinning
(continuation)

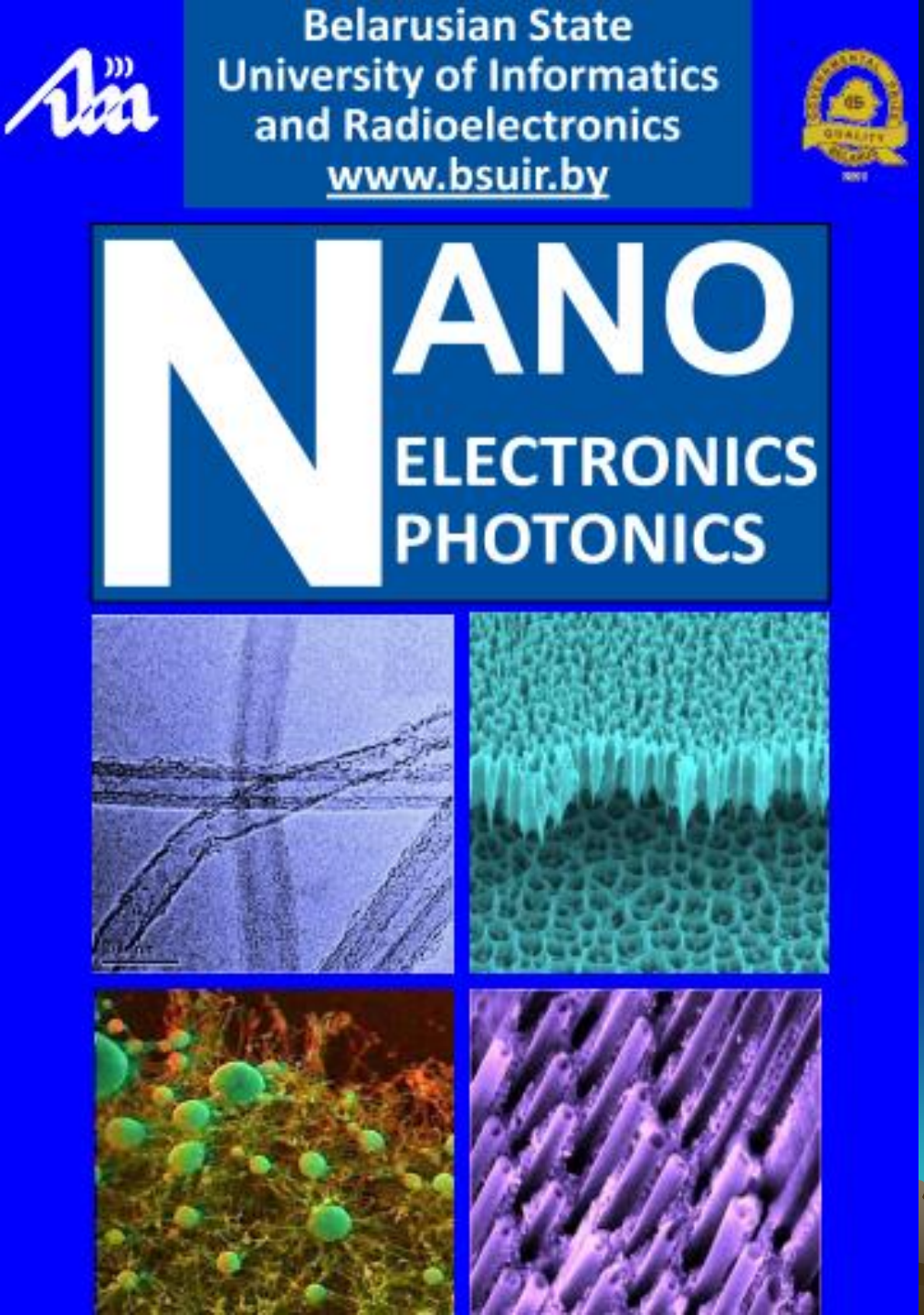
- **Task 2.2 Twin with BUW with respect to Research topic B**
- **The work performed in collaboration with BUW has been focused on investigation of field-emission properties of structured carbon nanotube (CNT) cathodes of two types, and horizontally oriented self-organized CNT networks.**
- **For CNT structured cathode fabrication, several types of patterned Si/SiO2 substrate were prepared using thermal or anode oxidation, metal sputtering, lithography, and chemical/plasma etching. Then, aligned CNT arrays were synthesized by chemical vapour deposition process at specific conditions when CNT arrays are formed selectively only on the surface Si of Si/SiO2 substrate. As a result, a set of samples of structured CNT cathodes of column shape of various geometrical parameters (CNT column aspect ratio, distance between CNT columns), and strip-shape CNT cathodes were prepared (at BSUIR).**
- **Then, their morphology was characterized by scanning electron microscopy. The spatially resolved measurements of field-emission properties of the structured CNT cathodes were investigated by field emission scanning microscope (FESM). In particular, current-voltage curves with the corresponding Fouler-Nordheim plots were measured, as well as long-term stability tests were performed (at BUW).**

WP2. Twinning
(continuation)

- On the basis of the performed experimental work, two joint reports at the 25th International Vacuum Nanoelectronics Conference (IVNC 2012, July 9th-13th, 2012), Korea were presented.
- One full-width article is to be published in the scientific journal.
- Chapter (35 pages) under the title “Field emission cathodes based on structured carbon nanotube arrays” to the book “InTech-Recent progress in carbon nanotubes research/ Book 1” is prepared and would be submitted in September. Belarusian State University of Informatics and Radioelectronics, Minsk, Belarus; Bergische Universität Wuppertal, Wuppertal, Germany; and Scientific and Manufacturing Complex “Technological Centre,” Moscow Institute of Electronic Technology”, Zelenograd, Russia are participating in this edition.
- In order to realize the aforementioned, one trip of a BSUIR team member of Research topics B to BUW was made (since 30 of April to 16 of May 2012).
- 4 BSUIR persons participated in the International Scientific Conference entitled “Fundamental and Applied NanoElectroMagnetics” (FANEM’12) held in Belarusian State University, Minsk, Belarus, May 22-25, 2012 under EU FP7 Project № 266529 BY-NanoERA (http://nano.bsu.by/fanem12/).

WP3. Dissemination and promotion

- In the WP3 *BSUIR* has spent efforts on the following activities:
- **Task 3.1** Definition of a Dissemination and Promotional plan
- Prepared the Dissimination and Promotion Plan (D3.1) describing the procedures to be followed during the BELERA project implementation in order to achieve an appropriate dissemination of BELERA results and promotion of BSUIR;
- **Task 3.2** Portal Design, Implementation and maintenance
- Designed and launched in time the BELERA web-site (D3.2),
- **Task 3.3** Production of project Promotional Material
- Prepared the BELERA Project leaflet and Poster (D3.3);
- Published a joint scientific paper with CNRS-InESS in the Journal of Applied Physics. The support of the European Commission under contract FP7 BELERA Project is acknowledged at the end of the article;
- Published two scientific reports in IVNC2012 Conference Digest with BUW
- **Task 3.4** Promotion of BELERA,BSUIR and FP7 within Belarus
- Prepared the promotional brochure about BSUIR (D3.4)



Front page of Booklet

4. Deliverables

Deliverable	Date	Comments
D1.1 Management and Quality Plan	March, 2012	Prepared with assistance of Innoveo and presented
D1.2 Synthetic activity report covering 1st semester	July, 2012	Prepared and presented
D3.1 Dissemination and Promotion Plan	March, 2012	Prepared with assistance of Innoveo and presented
D3.2 Website	July, 2012	website was launched in the middle of June; in July – "final version"
D3.3 Project leaflet and poster	July, 2012	Prepared and presented
D3.4 Promotion brochure about BSUIR	August, 2012	Prepared and presented in electronic version

WP**5.** Strategy Development

- **Task 5.1** Prepare a feasibility study of a Nanoelectronics and Nanophotonics technology Platform
- **Task 5.2** Evaluation of BSUIR
- **Task 5.3** Strategy development for BSUIR
- **Task 5.4** Monitoring of BSUIR

7. Publicity and dissemination actions and project events

- **Presentation in events:**
- The dissemination of the knowledge on the BELERA Project was made by BSUIR at the following International events:
- 1. Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore, India (31 march April 2012).
- 2. Indian Institute of Science, Centre for Nano Science (CeNSE), Department of Electrical Communication Engineering, Bangalor, India. (1 April 2012),
- 3. Fourth ICPC NanoNet Workshop, Goa, India. (2 -4 April 2012).
- 5. Institute for Informatics and Instrumentation, Moscow, Russia, Conference "Tendencies in Nanotechnolology"(29 May 2012).
- 6. Public Chamber of Deputies, Moscow, Russia, during the lecture "Energy related applications of carbon-based allotropies", (30 May 2012).
- 7. Belarus – Korea Forum: "Innovations in Science and Technology", Minsk, Belarus, (25,26 June 2012)
- 8. International Scientific Conference entitled "Fundamental and Applied NanoElectroMagnetics" (FANEM'12) held in Belarusian State University, Minsk, Belarus, May 22-25, 2012

7. Publicity and dissemination actions and project events (continuation)

- **Press release:**
- 1. Published a joint scientific paper with CNRS-InESS in the Journal of Applied Physics. The support of the European Commission under contract FP7 BELERA Project is acknowledged at the end of the article (J. Appl. Phys. 112, 024302 (2012); http://dx.doi.org/10.1063/1.4737119);
- 2. Published two scientific reports in IVNC2012 Conference Digest with BUW: Poster Session 1 (15:10 – 17:10, July 10):
- №19. (P1-19) Method of Low-temperature Formation of Horizontally Aligned CNT networks on various substrates, and №35. (P2-35) Field emission properties of self-structured CNT networks deposited at temperatures below 150°C (http://www.ivnc2012.org/)
- 3. One scientific article jointly with BUW is submitted to Journal of Vacuum Science & *Technology B*

- Scope

- The Conference is being organized as an international forum of specialists in science, technology, and application of nanostructures. The scope is:
- **- physics of nanostructures**
  - chemistry of nanostructures
  - nanotechnology
  - nanosized optical and electronic devices
- Special Session "Frontiers of Nanotechnologies and Nanomaterials for Renewable Energy Generation, Conversion and Storage".
- Special Session "Nanostructured materials for electronics and photonics".
- The Scientific Program of the Conference will be composed of invited review talks, oral presentations and poster session. The Conference language is English.
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http://www.nanomeeting.org/