Available online at www.sciencedirect.com

ScienceDirect

St. Petersburg Polytechnical University Journal: Physics and Mathematics 1 (2015) 101–107

www.elsevier.com/locate/spjpm

The results of the 16th all-Russian youth conference on semiconductor and nanostructure physics and semiconductor opto- and nanoelectronics

T.A. Gavricova, V.A. Zykov*, V.I. Ilyin

St. Petersburg Polytechnic University, 29 Politekhnicheskaya St., St. Petersburg, 195251, Russian Federation

Available online 11 March 2015

Abstract

The paper summarizes the results of the conference and describes the conference organizers and sponsors. The high standards for the materials submitted by undergraduate and graduate students were set by reports from two guest speakers of Ioffe Physical–Technical Institute. The paper includes an analytic review covering reports from all six sections of the conference and lists all reports that have been commended by the Program Committee and awarded certificates and money prizes. A number of reports were recommended for participation in the Member of Youth Science and Innovation Competition program in the 'Scientific results which have significant novelty and the prospect of commercialization' category and shall be further funded by the Foundation for Assistance to Small Innovative Enterprises in Science and Technology.

Keywords: Physics of semiconductors; Nanostructure; Optoelectronics; Nanoelectronics.

The 16th all-Russian youth conference on semiconductor and nanostructure physics and opto- and nanoelectronics took place on November 24–28, 2014 in the conference center of the St. Petersburg Academic University. This traditional event was organized by St. Petersburg Polytechnic University, St. Petersburg Academic University and Nanotechnology Research and Education Centre of the Russian Academy of Sciences, Ioffe Physical–Technical Institute of the Russian Academy of Sciences, and St. Petersburg State University.

* Corresponding author. Tel.: +7 812 552 9671.
E-mail addresses: zykov@rphf.spbstu.ru (V.A. Zykov), vilyin@rphf.spbstu.ru (V.I. Ilyin).

The conference was held with the support of the Russian Foundation of Basic Research (RFBR project 14-32-10042), the non-profit Dynasty Foundation, and the ATC-Semiconductor Devices company.

The organization of the conference owes much to the efforts of the Program Committee, headed by a member of RAS Dr. R.A. Suris of Ioffe Physical–Technical Institute, and the Organizational Committee, headed by Dr. L.E. Vorobiev, of St. Petersburg Polytechnic University.

The conference's published proceedings consisted of ninety-two reports by undergraduate and graduate students from more than twenty universities and research centers of thirteen Russian cities such as Moscow, St. Petersburg, Ekaterinburg, Nizhny Novgorod, Penza, Volgograd, Tula, and Taganrog.

http://dx.doi.org/10.1016/j.spjpm.2015.03.004

The conference program included two reports by guest speakers who are among the foremost Russian scientists. These were 'Nitrides: the 4th Nobel Prize on semiconductor heterostructures' by a corresponding member of RAS Dr. P.S. Kopyev, and 'The 21st century is the era of precision cosmology' by Dr. A.V. Ivanchik (both of Ioffe Physical–Technical Institute).

The students gave forty-one spoken reports during the nine plenary sessions. A poster session, during which forty-three reports were given, was held in six sections that were 'Bulk properties of semiconductors'; 'Structure growth, surface and interfaces'; 'Heterostructures, superlattices, quantum wells'; 'Quantum wires, quantum dots and other low-dimensional systems'; 'Optoelectronics and nanoelectronics devices'; 'Novel materials'.

Analytic Review

The conference program covered the main trends of modern semiconductor and nanostructure physics and semiconductor opto- and nanoelectronics in Russia. These are the studies of bulk properties (electrical, magnetic, optical, luminescent and photoelectric) of new and traditional materials and a comprehensive analysis of semiconductor surfaces and interfaces. Heterostructures and low-dimensional structures are also widely studied. The conference participants presented reports on quantum well, quantum wire and quantum dot and nanocluster structures, and nanocomposites and other new materials and structures. There was a pronounced interest in carbon-based structures, e.g. fullerenes, carbon tubes, and graphene. The discussion touched upon the problems of fabricating semiconductor structures and devices. Prominent Russian scientists communicated to the young researchers the problems of modern physics and the state of research in semiconductor and nanostructure physics as well as in opto- and nanoelectronics. These reports set a high standard of discussion for each working day of the conference.

Among the reports that have been presented in the 'Bulk properties of semiconductors' section those meriting particular attention are the results of studies of physical properties and technologies of materials and structures based on group III B-nitrides. These are a theoretical and experimental study of the optical properties of *n*-GaN/sapphire microstructures in infrared and terahertz ranges, which may be useful in manufacturing the sources of terahertz radiation; an analysis of photoconductivity spectra (registered for the first time) and the photoexcitation kinetics of indium nitride for interband transitions at room and helium temperatures. The results of the dislocation structure study of bulk layers of gallium nitride grown on patterned sapphire substrates are of much practical importance. Interesting results were obtained in the study of the electric properties of multicomponent chalcogenides of negative magnetoresistance at high pressures and low temperatures in a Cu–In–As–Se system; of current relaxation in a disordered Pb_3O_4 semiconductor; in a theoretical study of magnetization oscillations and exciton spectrum in irradiated ferromagnetic semiconductors; of energy interchange of phase-modulated beams in gyrotropic photorefractive crystals.

Reports from the 'Structure growth, surface and interfaces' section cover a wide array of studies on surface morphology, relief, and surface potential distribution, nanocluster formation, and atomic level analysis of the initial stages of growth and interface formation in heterostructures. The studies used the most up-to-date technologies, such as molecular-beam and gas-phase epitaxy, ion–plasma sputtering, and electrochemical anodic oxidation, among others.

One of the most promising works in this area had the goal of researching the possibilities of boron chloride plasma treatment for ohmic contact formation in GaN/AlGaN-based structures; others developed a method of analyzing stress–strain material states by diagnosing sample surface roughness using atomic force microscopy. Studies into the interaction of hydrogen with dislocations in silicon have yielded results that may be instrumental in improving the performance parameters of silicon-based solar cells through the enhancement of the hydrogenation process.

Some other problems discussed were the influence of microstructure on the nature of nonequilibrium processes in lead selenide films; the epitaxial growth of a hexagonal modification of silicon on sapphire; a method for estimating layer thickness in a 3C/6H SiC structure; hydrogen absorption and vacancy formation on a 2D boron surface; the growth processes in ultrathin cobalt and cobalt silicide films on a Si(111) surface; the potential of a method of incongruent vaporization for growing type A_3B_5/A_2B_6 multi-component nanoheterostructures.

Noteworthy studies were conducted on the formation of low-dimensional Al_2O_3 films on porous silicon substrates and on the examination of nanometric areas with the use of scanning spreading resistance microscopy.

The Program Committee commended the works on terahertz reflection and emission associated with nonequilibrium surface plasmon polaritons in *n*-GaN, and on the processes of ion implantation in photosensitive structures backside-illuminated using