



ABSTRACT BOOK

International research
and practice conference:

**NANOTECHNOLOGY
AND NANOMATERIALS
(NANO-2022)**

25-27 August 2022
Lviv, Ukraine

**INTERNATIONAL RESEARCH
AND PRACTICE CONFERENCE
“NANOTECHNOLOGY
AND NANOMATERIALS”**

(The NANO-2022 Conference is dedicated
to the International Year of Basic Sciences
for Sustainable Development)

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Abstract book

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This book contains the abstracts of contributions presented at the International research and practice conference “Nanotechnology and Nanomaterials” (NANO-2022).

The NANO-2022 Conference was organized by the Institute of Physics of NAS of Ukraine with the participation of the University of Tartu (Estonia), the Lviv Polytechnic National University, University of Turin (Italy) and Pierre and Marie Curie University – Paris 6 (France).

NANO-2021 was the ninth conference in the series of NANO-conferences initiated by the Institute of Physics of NAS of Ukraine in 2012 in the framework of FP7 Nanotwinning project. From year to year, they attract more attention and participants. In 2012, the first meeting was held in the format of International Summer School for young scientists «Nanotechnology: from fundamental research to innovations». The 2013 and 2014 conferences were organized in conjunction with the International Summer Schools for young scientists under the same title. In 2013, this event was attended by more than 300 scientists, in 2014-2017, 450 scientists took part and in 2018 it gathered above 650 participants. In 2021 conference was attended by more than 700 scientists from Ukraine, Poland, Italy, Estonia, France, Austria, Germany, Greece, Turkey, USA, Romania, Moldova, Czech Republic, Taiwan, Lithuania, Egypt, Iran, India, Algeria, Indonesia and other countries. In 2021 the Organizer Committee has received more than 800 application forms from about 25 countries of the world.

The NANO-2022 conference brought together leading scientists and young researchers from many countries of the world. This year its topics were as follows: Nanobiotechnology for health-care; Nanochemistry and biotechnology; Nanocomposites and nanomaterials; Nanoobjects microscopy; Nanooptics and photonics; Nanoplasmonics and surface enhanced spectroscopy; Nanoscale physics; Nanostructured surfaces; Physico-chemical nanomaterials science.

Website of the Nano-2022 conference: <http://nano-conference.iop.kiev.ua>

In order to support the formation of the communications between the scientific and innovation communities the EEN-Ukraine consortium together with EEN partners in Germany organized STARTUP2022 competition for selection 10 the best Ukrainian startups for participation in the Start-up BW Summit, Germany.

The exciton spectrum of the quantum dot - quantum ring semiconductor nanostructure in an electric field

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The intensive development of nanotechnology has made it possible to create new nanostructures with clear geometric shapes. In particular, structures containing quantum dots and nanorings have already been created and are being intensively studied [1].

In this work, we investigate a nanostructure consisting of a cylindrical semiconductor quantum dot (quantum well, GaAs medium), which through a finite potential barrier ($\text{Al}_x\text{Ga}_{1-x}\text{As}$ medium) is tunnel-connected to a coaxial cylindrical nanoring (quantum well, GaAs medium).

Assuming that the lattice constant and the dielectric constant of the nanosystem elements differ slightly from each other, a model of effective masses and rectangular potentials is used to calculate the electron and hole spectra. These values are considered known in all areas of the nanosystem. All theoretical calculations were performed in a cylindrical coordinate system that is appropriate for this case. The corresponding stationary Schrödinger equations for noninteracting electrons and holes in the absence of an electric field are solved analytically exactly. Radial wave functions are obtained as a linear combination of the Bessel, Neumann and modified Bessel functions. The stationary Schrödinger equations for quasiparticles in the presence of an electric field are not analytically solved. For their approximate solution, the unknown wave functions are sought in the form of a decomposition over a complete set of cylindrically symmetric wave functions, and the energy of the electron or hole is found from the solution of the corresponding secular equation. Since the interaction energy between an electron and a hole is much less than the sum of the size-quantized energies of the corresponding quasiparticles, the exciton binding energy is found using perturbation theory.

The dependences of the energies of the electron, hole, and exciton on the magnitude of the electric field strength are analyzed.

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