

**RUSTAM A. KHABIBULLIN**

**Scientific Secretary, Leading Researcher**

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Research group homepage: [http://new.isvch.ru/sotr/khabibullin\\_en/](http://new.isvch.ru/sotr/khabibullin_en/)

**Education**

**Ph.D. in Physics, Moscow State Institute of Radio Engineering, Electronics and Automation (MIREA)** 2012

*Dissertation title:* "Investigation of electronic properties of quantum wells AlGaAs/InGaAs/AlGaAs with combined and delta-doping"  
Research advisor: Ivan S. Vasil'evskii

**Specialist in Physics and Math, National Research Nuclear University MEPhI (Moscow Engineering Physics Institute)** 2009

**Professional appointments**

**Institute of ultra-high frequency semiconductor electronics of Russian academy of sciences (IUHFSE RAS)**

Leading Researcher 2017–  
Scientific Secretary 2014–  
Senior Researcher 2013–2014  
Researcher 2012–2013

**Bauman Moscow State Technical University**

Senior Researcher 2014–2016

**Institute of Applied Physics of Russian academy of sciences**

Senior Researcher 2016

**National Research Nuclear University MEPhI (Moscow Engineering Physics Institute)**

Professor's Assistant 2012  
Engineer 2009–2012

**Research interests**

- Development of THz sources and detectors: quantum-cascade lasers, photo-conductive antennas, plasmonic HEMTs
- THz visualization based on self-mixing effect in QCL
- Low-dimensional systems (quantum wells, wires and dots): fabrication and investigation
- Microwave and mm-wave semiconductor devices and physics: HEMTs based on GaAs, InP and GaN

## Honors/Awards/Grants/Other

Certificate for participating in the 5 <sup>th</sup> International scientific and practical seminar: "Electron-beam lithography on Raith's equipment: from idea to realization"	2016
Winner of Skolkovo Summer school for young leaders (at OpUS)	2014
Scholarship Diploma of the Mokerov foundation for the support of science and education	2011
Diplomas for the best issue on Kurchatov school for young scientists	2009, 2011

## Reviewer service

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Member of the Editorial board of the "Journal of Nano and microsystem technique" (ISSN 1813-8586).  
The expert of the Russian Academy of Sciences (Identification number - 2016-01-4279-3116).  
Regular reviewer for IEEE Transactions on Terahertz Science and Technology, Laser Physics Letters, Applied Physics A.

## Teaching experience

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Scientific consultant of PhD Thesis: Sergei V. Mikhailovich "Frequency and noise parameters of the nanoheterostructure AlGa <sub>N</sub> /Ga <sub>N</sub> HEMT with different thickness of barrier layer"	2016
Author of two textbook for student: "Modeling band diagrams of heterostructures based on A <sup>3</sup> B <sup>5</sup> semiconductors" (ISBN - 978-5-9909382-0-5)	2016
"Fundamentals of molecular beam epitaxy and characterization of thin films" (ISBN - 978-5-9909382-1-2)	2016

## Language proficiency

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Russian: native  
English: advanced  
Spanish: basic

## Peer-reviewed publication list

- [1] V. A. Gergel, N. M. Gorshkova, R. A. Khabibullin, P. P. Maltsev, V. S. Minkin, S. A. Nikitov, A. Yu. Pavlov, V. V. Pavlovskiy, A. A. Trofimov, "Development of pulsed aolid-state generators of millimetre and submillimeter wavelengths based on multilayer GaAs/AlGaAs heterostructures, " *Proceedings of the Scientific-Practical Conference "Research and Development - 2016"*, pp.101-106, 2018.
- [2] D. I. Khusyainov, A. M. Buryakov, V. R. Bilyk, E. D. Mishina, D. S. Ponomarev, R. A. Khabibullin, A. E. Yachmenev, "Epitaxial stresses in an InGaAs photoconductive layer for terahertz antennas, " *Technical Physics Letters*, vol. 43, no. 22, pp. 48-54, 2017.
- [3] R. R. Reznik, N. V. Kryzhanovskaya, F. I. Zubov, A. E. Zhukov, R. A. Khabibullin, S. V. Morozov, G. E. Cirlin, "MBE growth, structural and optical properties of multilayer heterostructures for quantum-cascade laser, " *Journal of Physics: Conf. Series*, vol. 917, p. 052012, 2017.
- [4] D. S. Ponomarev, R. A. Khabibullin, A. E. Yachmenev, A. Yu. Pavlov, D. N. Slapovskiy, I. A. Glinskiy, D. V. Lavrukhin, O. A. Ruban, P. P. Maltsev, "Electrical and thermal properties of photoconductive antennas based on In<sub>x</sub>Ga<sub>1-x</sub>As (x > 0.3) with a metamorphic buffer layer for the generation of terahertz radiation, " *Semiconductors*, vol. 51, no. 9, pp. 1267-1272,

2017.

- [5] R. A. Khabibullin, O. G. Morozov, A. Z. Sakhabutdinov, I. I. Nureev, "Methods of spectrally pure two-frequency radiation forming for terahertz carriers generation in optical range," *Proc. IEEE, Systems of Signal Synchronization, Generating and Processing in Telecommunications 2017*.
- [6] S. V. Mikhailovich, R. R. Galiev, A. V. Zuev, A. Yu. Pavlov, D. S. Ponomarev, R. A. Khabibullin, "The influence of gate length on the electron injection of velocity in an AlGa<sub>N</sub>/AlN/GaN HEMT channel," *Technical Physics Letters*, vol. 43, no. 8, pp. 733-735, 2017.
- [7] G. B. Galiev, A. N. Klochkov, I. S. Vasilevskii, E. A. Klimov, S. S. Pushkarev, A. N. Vinichenko, R. A. Khabibullin, P. P. Maltsev, "Electron properties of surface InGaAs/InAlAs quantum wells with inverted doping on InP substrates," *Semiconductors*, vol. 51, no. 6, pp. 760-765, 2017.
- [8] R. A. Khabibullin, N. V. Shchavruk, A. N. Klochkov, I. A. Glinskiy, N. V. Zenchenko, D. S. Ponomarev, P. P. Maltsev, A. A. Zaycev, F. I. Zubov, A. E. Zhukov, G. E. Cirlin, Zh. I. Alferov, "Energy spectrum and thermal properties of a terahertz quantum-cascade laser based on the resonant-phonon depopulation scheme," *Semiconductors*, vol. 51, no. 4, pp. 514-519, 2017.
- [9] A. V. Ikonnikov, K. V. Marem'yanin, S. V. Morozov, V. I. Gavrilenko, A. Yu. Pavlov, N. V. Shchavruk, R. A. Khabibullin, R. R. Reznik, G. E. Cirlin, F. I. Zubov, A. E. Zhukov, Zh. I. Alferov, "Terahertz radiation generation in multilayer quantum-cascade heterostructures," *Technical Physics Letters*, vol. 43, no. 4, pp. 358-361, 2017.
- [10] D. S. Ponomarev, R. A. Khabibullin, A. E. Yachmenev, P. P. Maltsev, M. M. Grekhov, I. E. Ilyakov, B. V. Shishkin, R. A. Akhmedzhanov, "Terahertz radiation in InGaAs grown on a GaAs wafer with a metamorphic buffer layer under femtosecond laser excitation", *Semiconductors*, vol. 51, no. 4, pp. 509-513, 2017.
- [11] S. A. Nikitov, P. P. Maltsev, V. A. Gergel, A. V. Verhovtseva, N. M. Gorshkova, V. V. Pavlovskiy, V. S. Minkin, A. A. Trofimov, A. Y. Pavlov, and R. A. Khabibullin, "Thermo injecting electrical instability in the Al<sub>x</sub>Ga<sub>1-x</sub>As/GaAs heterostructures with tunnel-nontransparent potential barriers," *Proc. SPIE, International Conference on Micro- and Nano-Electronics 2016*, vol. 10224, p. 102240X, 2016.
- [12] I. Semenikhin, V. Vyurkov, A. Bugaev, R. Khabibullin, D. Ponomarev, A. Yachmenev, P. Maltsev, M. Ryzhii, T. Otsuji, and V. Ryzhii, "Sn nanowires in GaAs: experiment and simulation," *Proc. SPIE, International Conference on Micro- and Nano-Electronics 2016*, vol. 10224, p. 102240R., 2016.
- [13] R. A. Khabibullin, A. E. Yachmenev, D. V. Lavrukhin, D. S. Ponomarev, A. S. Bugayev, and P. P. Maltsev, "Electron transport and optical properties of structures with atomic tin nanowires on vicinal GaAs substrates," *Semiconductors*, vol. 50, no. 2, pp. 185-190, 2016.
- [14] R. A. Khabibullin, N. V. Shchavruk, A. Y. Pavlov, A. N. Klochkov, D. S. Ponomarev, I. A. Glinskiy, P. P. Maltsev, A. E. Zhukov, G. E. Cirlin, and Z. I. Alferov, "Terahertz Quantum-Cascade Laser Based on the Resonant-Phonon Depopulation Scheme," *International Journal of High Speed Electronics and Systems*, vol. 25, no. 03n04, p. 1640022, 2016.
- [15] R. R. Galiev, A. E. Yachmenev, A. S. Bugaev, G. B. Galiev, Y. V. Fedorov, E. A. Klimov, R. A. Khabibullin, D. S. Ponomarev, and P. P. Maltsev, "Promising materials for an electronic component base used to create terahertz frequency range (0.5-5.0 THz) generators and detectors," *Bulletin of the Russian Academy of Sciences: Physics*, vol. 80, no. 4, pp. 476-478, 2016.
- [16] D. S. Ponomarev, R. A. Khabibullin, A. E. Yachmenev, P. P. Maltsev, I. E. Ilyakov, B. V.

- Shiskin, and R. A. Akhmedzhanov, "Intensive Terahertz Radiation from InXGa1-XAs due to Photo-Dember Effect," *International Journal of High Speed Electronics and Systems*, vol. 25, no. 03n04, p. 1640023, 2016.
- [17] K. N. Tomosh, A. Y. Pavlov, V. Y. Pavlov, R. A. Khabibullin, S. S. Arutyunyan, and P. P. Maltsev, "Investigation of the fabrication processes of AlGa<sub>N</sub>/AlN/GaN HEMTs with in situ Si<sub>3</sub>N<sub>4</sub> passivation," *Semiconductors*, vol. 50, no. 10, pp. 1416–1420, 2016.
- [18] R. A. Khabibullin, N. V. Shchavruk, A. Y. Pavlov, D. S. Ponomarev, K. N. Tomosh, R. R. Galiev, P. P. Maltsev, A. E. Zhukov, G. E. Cirilin, F. I. Zubov, and Z. I. Alferov, "Fabrication of a terahertz quantum-cascade laser with a double metal waveguide based on multilayer GaAs/AlGaAs heterostructures," *Semiconductors*, vol. 50, no. 10, pp. 1377–1382, 2016.
- [19] R. A. Khabibullin, A. E. Yachmenev, D. V. Lavrukhin, D. S. Ponomarev, A. S. Bugayev, and P. P. Maltsev, "Pseudomorphic HEMT with Sn nanowires on a vicinal GaAs substrate," *Semiconductor Science and Technology*, vol. 30, no. 8, p. 085009, 2015.
- [20] G. B. Galiev, I. S. Vasil'evskii, E. A. Klimov, D. S. Ponomarev, R. A. Khabibullin, V. A. Kulbachinskii, D. V. Gromov, and P. P. Maltsev, "Quantum and transport scattering times in AlGaAs/InGaAs nanoheterostructures with AlAs inserts in the spacer layer," *Lithuanian Journal of Physics*, vol. 55, no. 4, pp. 249–254, 2015.
- [21] G. B. Galiev, R. A. Khabibullin, D. S. Ponomarev, A. E. Yachmenev, A. S. Bugaev, and P. P. Maltsev, "Metamorphic nanoheterostructures for millimeter-wave electronics," *Nanotechnologies in Russia*, vol. 10, no. 7–8, pp. 593–599, 2015.
- [22] D. V. Lavrukhin, A. E. Yachmenev, A. S. Bugaev, G. B. Galiev, E. A. Klimov, R. A. Khabibullin, D. S. Ponomarev, and P. P. Maltsev, "Investigation of the optical properties of GaAs with  $\delta$ -Si doping grown by molecular-beam epitaxy at low temperatures," *Semiconductors*, vol. 49, no. 7, pp. 911–914, 2015.
- [23] D. V. Lavrukhin, R. A. Khabibullin, D. S. Ponomarev, and P. P. Maltsev, "Photoluminescence of heterostructures containing an In<sub>x</sub>Ga<sub>1-x</sub>As quantum well with a high In content at different excitation powers," *Semiconductors*, vol. 49, no. 9, pp. 1218–1221, 2015.
- [24] D. V. Lavrukhin, A. E. Yachmenev, R. R. Galiev, A. S. Bugaev, Y. V. Fedorov, R. A. Khabibullin, D. S. Ponomarev, and P. P. Maltsev, "Investigation and Fabrication of the Semiconductor Devices Based on Metamorphic InAlAs/InGaAs/InAlAs Nanoheterostructures for THz Applications," *International Journal of High Speed Electronics and Systems*, vol. 24, no. 01n02, p. 1520001, 2015.
- [25] D. V. Lavrukhin, A. E. Yachmenev, R. R. Galiev, R. A. Khabibullin, D. S. Ponomarev, Y. V. Fedorov, and P. P. Maltsev, "MHEMT with a power-gain cut-off frequency of  $f_{max} = 0.63$  THz on the basis of a In<sub>0.42</sub>Al<sub>0.58</sub>As/In<sub>0.42</sub>Ga<sub>0.58</sub>As/In<sub>0.42</sub>Al<sub>0.58</sub>As/GaAs nanoheterostructure," *Semiconductors*, vol. 48, no. 1, pp. 69–72, 2014.
- [26] R. A. Khabibullin, G. B. Galiev, E. A. Klimov, D. S. Ponomarev, I. S. Vasil'evskii, V. A. Kulbachinskii, P. Y. Bokov, L. P. Avakyants, A. V. Chervyakov, and P. P. Maltsev, "Electrical and optical properties of near-surface AlGaAs/InGaAs/AlGaAs quantum wells with different quantum-well depths," *Semiconductors*, vol. 47, no. 9, pp. 1203–1208, 2013.
- [27] D. S. Ponomarev, I. S. Vasil'evskii, G. B. Galiev, E. A. Klimov, R. A. Khabibullin, V. A. Kulbachinskii, and N. A. Uzeeva, "Electron mobility and effective mass in composite InGaAs quantum wells with InAs and GaAs nanoinserts," *Semiconductors*, vol. 46, no. 4, pp. 484–490, 2012.
- [28] V. A. Kulbachinskii, N. A. Yuzeeva, G. B. Galiev, E. A. Klimov, I. S. Vasil'evskii, R. A. Khabibullin, and D. S. Ponomarev, "Electron effective masses in an InGaAs quantum well with InAs and GaAs inserts," *Semiconductor Science and Technology*, vol. 27, no. 3, p. 035021, 2012.

- [29] R. A. Khabibullin, I. S. Vasil'evskii, D. S. Ponomarev, G. B. Galiev, E. A. Klimov, L. P. Avakyanz, P. Y. Bokov, and A. V. Chervyakov, "The built-in electric field in P-HEMT heterostructures with near-surface quantum wells  $\text{Al}_x\text{Ga}_{1-x}\text{As}/\text{In}_y\text{Ga}_{1-y}\text{As}/\text{GaAs}$ ," *Journal of Physics: Conference Series*, vol. 345, p. 012015, 2012.
- [30] R. A. Khabibullin, I. S. Vasil'evskii, G. B. Galiev, E. A. Klimov, D. S. Ponomarev, R. A. Lunin, and V. A. Kulbachinskii, "Scattering and electron mobility in combination-doped HFET-structures  $\text{AlGaAs}/\text{InGaAs}/\text{AlGaAs}$  with high electron density," *Semiconductors*, vol. 45, no. 10, pp. 1321–1326, 2011.
- [31] R. A. Khabibullin, I. S. Vasil'evskii, G. B. Galiev, E. A. Klimov, D. S. Ponomarev, V. P. Gladkov, V. A. Kulbachinskii, A. N. Klochkov, and N. A. Uzeeva, "Effect of the built-in electric field on optical and electrical properties of  $\text{AlGaAs}/\text{InGaAs}/\text{GaAs}$  P-HEMT nanoheterostructures," *Semiconductors*, vol. 45, no. 5, pp. 657–662, 2011.

### Book Chapters

- [1] "Terahertz quantum-cascade laser based on the resonant-phonon depopulation scheme", Rustam A. Khabibullin, Nikolay V. Shchavruk, Aleksandr Yu. Pavlov, Alexey N. Klochkov, Dmitry S. Ponomarev, Igor A. Glinskiy and Petr P. Maltsev, *Fundamental and applied problems of terahertz devices and technologies- Selected Topics in Electronics and Systems*, vol. 58, pp. 103-108 edited by M. Ryzhii, A. Satou, T. Otsuji, (World Scientific Publishing Co. Pte. Ltd., 2017), ISBN 978-981-3223-27-1
- [2] "Intensive terahertz radiation from  $\text{In}_x\text{Ga}_{1-x}\text{As}$  due to photo-dember effect", Dmitry S. Ponomarev, Rustam A. Khabibullin, Aleksandr E. Yachmenev and Petr P. Maltsev, *Fundamental and applied problems of terahertz devices and technologies- Selected Topics in Electronics and Systems*, vol. 58, pp. 109-116 edited by M. Ryzhii, A. Satou, T. Otsuji, (World Scientific Publishing Co. Pte. Ltd., 2017), ISBN 978-981-3223-27-1

### Invited Conference Talks, Seminars, and Tutorials (since 2016)

- [1] I. A. Glinskiy, D. S. Ponomarev, R. A. Khabibullin, A. E. Yachmenev, N. V. Zenchenko, "Efficiency of optical-terahertz conversion in photoconductive antennas based on LT GaAs and  $\text{In}_{0.38}\text{Ga}_{0.62}\text{As}$ ," INTERMATIC-2017, Moscow, November 20-24, 2017 **(Oral talk)**
- [2] I. A. Glinskiy, N. V. Zenchenko, D. S. Ponomarev, R. A. Khabibullin, A. E. Yachmenev, "Investigation of the efficiency of conversion of optical radiation into terahertz in photoconductive antennas based on  $\text{In}_{0.38}\text{Ga}_{0.62}\text{As}$ ". XV Kurchatov Interdisciplinary Youth Scientific School, Moscow, November 14 – 17, 2017**(Oral talk)**
- [3] D. I. Khusyainov, A. M. Buryakov, V. R. Bilyk, E. D. Mishina, D. S. Ponomarev, R. A. Khabibullin, A. E. Yachmenev, "Epitaxial stresses in InGaAs photoconductive layer for THz antennas," International Microwave Workshop Series on Advanced Materials and Processes (IMWS-AMP 2017), Pavia (Italy), September 20-22, 2017 **(Poster Sessions)**
- [4] R. A. Khabibullin, O. G. Morozov, A. A. Kuznetsov, "Methods of spectrally pure two-frequency radiation formation for generation of terahertz carriers in optical rang," 26th International Laser Physics Workshop (LPHYS'17), Kazan, July 17-21, 2017 **(Oral talk)**
- [5] R. A. Khabibullin, O. G. Morozov, A. Z. Sakhabutdinov, I. I. Nureev, "Methods of spectrally pure two-frequency radiation forming for terahertz carriers generation in optical range," 2017 Systems of Signal Synchronization, Generating and Processing in Telecommunications (SINKHROINFO), Kazan, July 3-4, 2017 **(Oral talk)**

- [6] F.I. Zubov, A.V. Ikonnikov, K.V. Maremyanin, S.V. Morozov, V.I. Gavrilenko, A.Yu. Pavlov, N.V. Shchavruk, R.A. Khabibullin, R.R. Reznik, G.E. Cirlin, N.V. Kryzhanovskaya, A.E. Zhukov and Zh.I. Alferov. "Development and study of terahertz quantum-cascade lasers with metallic waveguide", 25<sup>th</sup> International Symposium Nanostructures: Physics and technology, Saint Petersburg, June 26-30, 2017 **(Oral talk)**
- [7] R. A. Khabibullin, N. V. Shchavruk, A. Yu. Pavlov, D. N. Slapovskiy, R. R. Galiev, K. N. Tomosh, A. N. Klochkov, D. S. Ponomarev, F. I. Zubov, G. E. Cirlin, A. E. Zhukov. "Current state and prospects of development of terahertz quantum cascade laser in Russia", VIII International Conference on Physics and Technology of Nanoheterostructure Microwave Electronics "Open Readings named after RAS Corresponding Member, Professor V.G. Mokerov", Moscow, May 24, 2017 **(Plenary talk)**
- [8] R. A. Khabibullin, N. V. Shchavruk, D. S. Ponomarev, V. I. Gavrilenko, S. V. Morozov, G. E. Cirlin, A. E. Zhukov. "Design and fabrication of terahertz quantum-cascade lasers", 11<sup>th</sup> Belarusian-Russian Workshop Semiconductor Lasers and systems, Minsk, May 22-26, 2017 **(Invited talk)**
- [9] R. A. Khabibullin, P.P. Maltsev. "The first terahertz quantum-cascade laser fabricated in Russia", The tenth anniversary of the journal "Photonics", Moscow, April 5, 2017 **(Invited talk)**
- [10] S. Morozov, V. V. Rumyantsev, A. V. Ikonnikov, A. A. Dubinov, M. A. Fadeev, A. M. Kadykov, K. E. Kudryavtsev, N. N. Mikhailov, S. A. Dvoretckiy, V. I. Gavrilenko, I. I. Zasavitskii, A. U. Pavlov, N. V. Schavruk, R. A. Khabibulin, R. R. Reznik, G. E. Cirlin, F. I. Zubov, A. E. Zhukov, J. I. Alferov. "Terahertz lasers based on semiconductor nanostructures", 4th International School and Conference on Optoelectronics, Photonics, Engineering and Nanostructures (SPb OPEN-2107), Book of abstracts, pp. 38-42, Saint Petersburg, April 3-6, 2017 **(Invited talk)**
- [11] R. A. Khabibullin, D. S. Ponomarev, P. P. Maltsev, V. A. Gergel. "Development and fabrication of THz source based on multilayer GaAs/AlGaAs heterostructures", XXI International symposium "Nanophysics & Nanoelectronics", Nizhny Novgorod, March 13-16, 2017 **(Invited talk)**
- [12] D. S. Ponomarev, R. A. Khabibullin, A. E. Yachmenev, P. P. Maltsev, I. E. Ilyakov, B. V. Shishkin, R. A. Akhmedzhanov. "The influence of the photo-dember effect on the generation of THz radiation in In<sub>x</sub>Ga<sub>1-x</sub>As (x>0.3) with metamorphic buffer layer", XXI International symposium "Nanophysics & Nanoelectronics", Nizhny Novgorod, March 13-16, 2017 **(Poster Sessions)**
- [13] R. A. Khabibullin, N. V. Shchavruk, A. Yu. Pavlov, A. N. Klochkov, D. S. Ponomarev, A. E. Zhukov, G. E. Cirlin, V. A. Gergel, S. A. Nikitov. "Design and fabrication of terahertz sources based on multilayer GaAs/AlGaAs heterostructures", VI International Conference "Frontiers of Nonlinear Physics", Nizhny Novgorod – St. Petersburg, July 17-23, 2016. **(Oral talk)**
- [14] R. A. Khabibullin, N. V. Shchavruk, A. Yu. Pavlov, A. N. Klochkov, D. S. Ponomarev, I. A. Glinskiy, P. P. Maltsev, A. E. Zhukov, G. E. Cirlin, Zh. I. Alferov. "Terahertz quantum-cascade laser based on the resonant-photon depopulation scheme", 5th Russia-Japan-USA-Europe Symposium on Fundamental and Applied Problems of Terahertz Devices and Technologies, Sendai (Japan), Oct. 31 – Nov. 4, 2016. **(Poster Sessions)**
- [15] R. A. Khabibullin. "Development and production of terahertz quantum cascade laser with a double metal waveguide based on In-Au and Au-Au thermocompression bonding", The first BRICS Conference on Photonics, Skolkovo Institute of Science and Technology, May 30-31, 2016. **(Invited talk)**

- [16] R. A. Khabibullin, N. V. Shchavruk, A. Yu. Pavlov, D. N. Slapovskiy, R. R. Galiev, K. N. Tomosh, A. N. Klochkov, D. S. Ponomarev, G. E. Cirlin, A. E. Zhukov, "Design and fabrication of terahertz quantum-cascade lasers with double metal waveguide based on multilayer GaAs/AlGaAs heterostructures", VII International Conference on Physics and Technology of Nanoheterostructure Microwave Electronics "Open Readings named after RAS Corresponding Member, Professor V.G. Mokerov", Moscow, May 25, 2016 **(Oral talk)**
- [17] F. I. Zubov, A. V. Ikonnikov, S. V. Morozov, R. A. Khabibullin, G. E. Cirlin, A. E. Zhukov. "Development and investigation of terahertz quantum cascade laser (3 THz) based on AlGaAs/GaAs heterostructures", 5<sup>th</sup> Russian symposium with international participation Semiconductor lasers: physics and technology, November 15-18, 2016 **(Oral talk)**
- [18] S. A. Nikitov, P. P. Maltsev, V. A. Gergel, A. V. Verhovtseva, N. M. Gorshkova, V. V. Pavlovskiy, V. S. Minkin, A. A. Trofimov, A. Y. Pavlov, and R. A. Khabibullin, "Thermo injecting electrical instability in the Al<sub>x</sub>Ga<sub>1-x</sub>As/GaAs heterostructures with tunnel-nontransparent potential barriers," International Conference "Micro- and Nano-Electronics-2016", Zvenigorod, October 3-7, 2016. **(Oral talk)**
- [19] I. Semenikhin, V. Vyurkov, A. Bugaev, R. Khabibullin, D. Ponomarev, A. Yachmenev, P. Maltsev, M. Ryzhii, T. Otsuji, and V. Ryzhii, "Sn nanowires in GaAs: experiment and simulation," International Conference "Micro- and Nano-Electronics-2016", Zvenigorod, October 3-7, 2016. **(Oral talk)**

- [1] *Patent Number: RU113072-U1.* R.A. Khabibullin, E.A. Klimov, G.B. Galiev, I.S. Vasilevskii et al. Semiconductor nano-heterostructure has stepped quantum well that has upper and lower interfacial gallium-arsenide layers, each having two layers separated by gallium-arsenide layer and alloyed indium-gallium-arsenide layer.
  
- [2] *Patent Number: RU113071-U1.* D.S. Ponomarev, R.A. Khabibullin, E.A. Klimov, G.B. Galiev, I.S. Vasilevskii. Semiconductor nanoheterostructure, has semi-insulating base layer, buffer layer and active layer, where one of three layers is arranged in delta-layer of donor atoms, and active layer is symmetrical about center of quantum well.
  
- [3] *Patent Number: RU2581744-U1.* R.A. Khabibullin, E.A. Klimov, G.B. Galiev et al. The method of determining the lattice parameter in the selected small region of the epitaxial layer with a gradient of chemical composition.
  
- [4] *Patent Number: RU2582440-U1.* R.A. Khabibullin, E.A. Klimov, G.B. Galiev et al. The semiconductor nanoheterostructures on a GaAs substrate with a modified stop layer  $\text{Al}_x\text{Ga}_{1-x}\text{As}$ .