



Curriculum Vitae

Rostislav V. LAPSHIN, Ph. D.

an experienced researcher-developer-microscopist

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SUMMARY

During successful research and development career, a broad range of topical problems in scanning probe microscopy and nanotechnology has been covered. New ideas, original solutions, instrument enhancements, accurate measurement methods, optimized designs, advanced control techniques and effective algorithms were suggested, proved experimentally and presented for international scientific community. Reputation for being able to understand and solve complex technical problems; formulate perspective research plans; identify critical patent claims; reveal a probable commercial future of the work. Key skills include: theoretical and experimental development of measuring methodologies; data acquisition, treatment and analysis; conceptual and mathematical modeling of crucial relationships; computer programming; writing reports, application notes, research papers and grant proposals.

PROFESSIONAL EMPLOYMENT

Term: January 1996 – present

Employer: Institute of Physical Problems named after F. V. Lukin

Address: Zelenograd, Moscow, 124460, Russian Federation

Field: Scanning probe microscopy and nanotechnology

Position: Staff scientist

Activities: As SPM-microscopist, participated in experimental STM/AFM investigations (ambient, low-energy plasma, HV, and UHV environments) of porous Si surface, GaAlAs heterostructures, ordered SiO₂ nanoparticles (photonic crystals), SiNbN superconductor microwave sensor, nanostructured electrochemically-polished Al, ordered porous Al₂O₃, Pd clusters, carbon nanotubes (CNT), surface ordered structures (MePhSiCl₂, VOCl₃, TiCl₄) and other materials. Researched feature formation by local probe oxidation of thin films (Ti, Zr, WC, MoC, etc.) and by indenting a probe into plastic surface (Au, Al, Cu, polycarbonate, Langmuir-Blodgett film, etc.) to develop a record medium for a large capacity probe storage device (PSD). Made critical probe nanolithography to form a junction of a field-effect nanotransistor. Conducted investigations of thin carbon films plasma-deposited on low-density polyethylene (LDPE), polyurethane (PU), and poly(methyl methacrylate) (PMMA) in order to improve biocompatibility of artificial human implants (blood-vessels, crystalline lens, mitral valves, etc.) fabricated of these materials.

Researched influence of vacuum ultraviolet (VUV) on surface morphology and properties of poly(methyl methacrylate). Investigated nanostructuring of spin-coated poly(methyl methacrylate) film in oxygen RF-plasma. Studied pores formation in highly oriented pyrolytic graphite (HOPG) treated in oxygen RF-plasma. Investigated formation of quantum dots of C, Ni, Si on Si(100) and Si(111) substrates in glow-discharge Ar-plasma. Developed a deposition process of catalytic Ni nanoparticles on Si(100) substrate that made possible a low-temperature synthesis of carbon nanostructures (nanospheres, nanotori) by plasma-enhanced chemical vapor deposition (PECVD) method.

As SPM-developer, solved task of automatic scanner calibration by natural standards such as crystal-line lattices. Elaborated a simple readback method for a probe storage device, which memory bits were represented by single atoms/molecules. Suggested a feature-oriented scanning-positioning methodology

intended for implementation of high precision SPM-measurements, automatic surface characterization and unmanned bottom-up nanofabrication. Developed an automatic drift correction method built on techniques of counter-scanning and topography feature recognition. Built up an AFM-based setup and conduct measurements of bimaterial microcantilevers used as room-temperature IR-sensors. Formulated operation principles, suggested construction, and control methods of a high-precision versatile walking robot-nanopositioner intended for use in SPM and various nanotechnological processes. Developed a method for automatic distributed calibration of probe microscope scanner in nanometer range.

Term: February 1990 – January 1996

Employer: “Delta” Microelectronics and Nanotechnology Research Institute

Address: 2 Schelkovskoye shosse, Moscow, 105122, Russian Federation

Field: Scanning tunneling microscopy

Position: Researcher

Activities: Worked on a fast-acting scanning tunneling microscope (STM), in particular, a fast-acting digital control system intended for tunnel junction stabilization. Developed a method correcting STM piezo-scanner nonlinearity and hysteresis. Within bounds of the above tasks carried out: formulation of technical requirements; prototype analysis; working-out of instrument concept and basic architecture solutions; building of a math model; engineering calculations and estimates; synthesis of flow-charts and operation algorithms; design of principle digital schemes (logic, ADC, DAC, i/o interface, embedded microcontroller); writing and debugging of a program kernel for microscope low-level control; design of calibration and self-testing routines; assemblage and test of the experimental STM.

Term: April 1988 – September 1989

Employer: “Rhythm” Ad hoc Creative Team at the Moscow State Technical University named after N. E. Bauman

Address: 2-ya Baumanskaya St., bldg. 5, Moscow, 107005, Russian Federation

Field: Precision mechanics

Position: Engineer

Activities: Developed a specialized equipment to balance video rotary heads of a tape recorder. Dealt with measurement automation, math data processing and sensor conjugation with a local controller.

ACHIEVEMENTS IN SCIENCE

- Conducted drift-insensitive distributed calibration of a probe microscope scanner in nanometer scale by crystal lattice as a length standard, 2011
- Proposed and experimentally approved a new method for preparation of catalytic nickel nanoparticles of controlled sizes in glow-discharge plasma, 2011
- Formulated operation principles, suggested construction, and control methods of a versatile miniature walking robot-nanopositioner intended for high-precision manipulation of samples, substrates, micro/nanosensors, and micro/nanotools, 2010
- Developed a deposition process of catalytic nickel nanoparticles making possible a low-temperature synthesis of carbon nanostructures by plasma-enhanced chemical vapor deposition method, 2009
- Demonstrated smoothing of nanoscale asperities of poly(methyl methacrylate) surface under vacuum ultraviolet irradiation, 2008
- Discovered a nanostructuring and partial ordering of poly(methyl methacrylate) surface treated in oxygen radio-frequency plasma, 2006
- Suggested a novel drift-insensitive distributed approach for calibration of a probe microscope scanner in nanometer scale by natural measures, 2005
- Developed a new counter-scanning technique intended for automatic correction of scan distortions induced by probe drift relative to a sample surface, 2005
- Proposed, developed and experimentally proved an original feature-oriented scanning methodology applicable for both high precision surface measurements and unmanned bottom-up nanofabrication, 1999
- With a scanning tunneling microscope conducted a measurement of distance between two surface atoms with the highest ever done before precision, 1999
- First conducted at room temperature a low-noise scanning tunneling spectroscopy localized precisely on a single surface atom, 1999

- First demonstrated on crystal surface a probe tracking by single atoms as data bits of a high-capacity probe storage, 1998
 - Proposed an original approximating model for hysteresis that permits to effectively correct nonlinearity of a probe microscope piezoscanner, 1993
 - Suggested a novel concept and design of a fast-acting scanning tunneling microscope which may serve as a platform for building a high-performance nanoassembler, 1993
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SELECTED PUBLICATIONS

- R. V. Lapshin, A. P. Alekhin, A. G. Kirilenko, S. L. Odintsov, V. A. Krotkov, *Vacuum ultraviolet smoothing of nanometer-scale asperities of poly(methyl methacrylate) surface*, Journal of Surface Investigation. X-ray, Synchrotron and Neutron Techniques, vol. 4, no. 1, pp. 1-11, 2010
 - R. V. Lapshin, *Automatic drift elimination in probe microscope images based on techniques of counter-scanning and topography feature recognition*, Measurement Science and Technology, vol. 18, iss. 3, pp. 907-927, 2007
 - R. V. Lapshin, *Feature-oriented scanning methodology for probe microscopy and nanotechnology*, Nanotechnology, vol. 15, iss. 9, pp. 1135-1151, 2004
 - R. V. Lapshin, *Object-oriented scanning for probe microscopy and nanotechnology*, Ph. D. thesis (in Russian), Moscow, 2002
 - R. V. Lapshin, *Digital data readback for a probe storage device*, Review of Scientific Instruments, vol. 71, no. 12, pp. 4607-4610, 2000
 - R. V. Lapshin, *Automatic lateral calibration of tunneling microscope scanners*, Review of Scientific Instruments, vol. 69, no. 9, pp. 3268-3276, 1998
 - R. V. Lapshin, *Analytical model for the approximation of hysteresis loop and its application to the scanning tunneling microscope*, Review of Scientific Instruments, vol. 66, no. 9, pp. 4718-4730, 1995.
 - R. V. Lapshin, O. V. Obyedkov, *Fast-acting piezoactuator and digital feedback loop for scanning tunneling microscopes*, Review of Scientific Instruments, vol. 64, no. 10, pp. 2883-2887, 1993.
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MAIN PATENTS

- R. V. Lapshin, P. V. Azanov, *Apparatus and method for preparing nanoparticles*, Application for Patent of Russian Federation, September, 2011
 - R. V. Lapshin, *Walking robot-nanopositioner and movement method*, Application for Patent of Russian Federation, no. 2010,120,927, May 26, 2010
 - R. V. Lapshin, *Method of correction of surface images obtained using scanning probe microscope and distorted with drift*, Patent of Russian Federation, no. 2,326,367, July 27, 2006
 - R. V. Lapshin, *Method for automatic distributed calibration of probe microscope scanner*, Patent of Russian Federation, no. 2,295,783, January 25, 2005
 - R. V. Lapshin, *Procedure of movement of sonde of scanning microscope-nanolithograph in field of coarse X-Y positioner*, Patent of Russian Federation, no. 2,181,212, September 7, 1999
 - R. V. Lapshin, *Method for measuring surface relief by means of scanning probe type microscope*, Patent of Russian Federation, no. 2,175,761, June 8, 1999
 - R. V. Lapshin, *Method for reading digital information in probe memory device*, Patent of Russian Federation, no. 2,181,218, November 2, 1998
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RESEARCH GRANTS

- *Synthesis and investigation of mesoscopic-scaled carbon nanostructures to form surfaces with biocompatible properties*, the Russian Foundation for Basic Research, 2005-2007
- *Application of algorithms and information methods for data readback in petabit capacity probe storage device*, the Russian Foundation for Basic Research, 2005
- *Development of low-temperature synchrotron radiation stimulated processes forming surface structures applicable to medicine*, the Moscow Committee on Science and Technologies, 2003-2004
- *Investigation of physical-chemical peculiarities of radiation-stimulated modification of surfaces of crystalline and noncrystalline solids aimed to form specific properties of the solids*, the Russian Foundation for Basic Research, 2002-2004

- *Nanotechnology development of polymer surface modification for medicine materials and manufactures*, the Moscow Committee on Science and Technologies, 2001
 - *Investigation of synchrotron light source induced chemisorption processes on semiconductor surfaces during synthesizing multilayer microstructures*, the Russian Foundation for Basic Research, 1998-2000
 - *Regular patterning of nanometer-sized metal layer on solid body surface: simulation, formation mechanisms, application to nanoelectronics*, the Russian Foundation for Basic Research, 1996-1998
 - Grant from the Fund of Physics of Solid Nanostructures, the Ministry of Science and Technologies, 1996
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SKILLS

Sample treatment/preparation: hands-on experience in specimen treatment in glow-discharge and RF-plasma, sample thinning for high-resolution transmission electron microscopy (HRTEM)

Optical instruments: hands-on working experience with optical profiler (interference microscope) and infrared microscope

Operation/maintenance: supervision of various low, high and ultrahigh vacuum equipment

Computer: competence in MathCAD, PCAD, Pascal, C, Assembler, and web design

Publishing: qualified for technical writing, reviewing, and editing

MEMBERSHIP

- A fellow of the Russian Society of Scanning Probe Microscopy and Nanotechnology since 1998
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SERVICES

- A referee of the Review of Scientific Instruments, the American Institute of Physics
 - A referee of Measurement Science and Technology, the Institute of Physics
 - A referee of Nanotechnology, the Institute of Physics
 - A referee of IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control, the IEEE Ultrasonics, Ferroelectrics, and Frequency Control Society
 - An expert of the Russian Corporation of Nanotechnologies
 - A supervisor of M. S. and Ph. D. students
 - A contributor to the Dictionary of Nanotechnological Terms, the Russian Corporation of Nanotechnologies
 - A contributor to Encyclopedia of Nanoscience and Nanotechnology, the American Scientific Publishers
 - A contributor to Wikipedia, the Free Encyclopedia
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HONOURS AND AWARDS

- Selected for the scientific photo exhibition *Art of Science 2011*, section *Microworld*, the artwork *Nanodonuts*, Moscow, Russian Federation, 2011
- Recipient of 5 prestigious diplomas *100 Best Russian Inventions*, the Federal Service for Intellectual Property, Patents and Trademarks (Rospatent), Moscow, Russian Federation, 2011
- Author of 5 patents recognized as *Perspective*, the Federal Service for Intellectual Property, Patents and Trademarks (Rospatent), Moscow, Russian Federation, 2010
- Selected for the scientific photo exhibition *Art of Science 2010*, section *Microworld*, the artwork *Nanogyri of polyurethane brain*, Moscow, Russian Federation, 2010
- Selected for the scientific photo exhibition *Science, this is beautiful!* (section *World that is hidden from us*), the artwork *Stonework of ancient Inca*, Moscow, Russian Federation, 2009
- Cited in the international biographical reference book *Leading Scientists of the World*, the International Biographical Centre, Cambridge, England, 2007
- Cited in the international biographical reference book *Leading Engineers of the World*, the International Biographical Centre, Cambridge, England, 2007

- Inclusion in the international biographical directory *Who's Who in Science and Engineering*, the Marquis Who's Who LLC, New Providence, USA, 2006, 2008
 - Named among the top 20 most popular authors of Nanotechnology journal for 2004, the Institute of Physics Publishing, Bristol, England, 2005
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EDUCATION

Term: January 2002 – December 2002

School: Institute of Physical Problems named after F. V. Lukin

Address: Zelenograd, Moscow, 124460, Russian Federation

Course: Postgraduate (extension)

Specialty: Solid body electronics, radio electronic components, micro and nanoelectronics, quantum devices (no. 05.27.01)

Degree: Ph. D.

Qualification: Scientist

Major: Scanning probe microscopy

Term: September 1990 – November 1993

School: "Scientific Center" Advanced Research Enterprise

Address: Zelenograd, Moscow, 103460, Russian Federation

Course: Postgraduate

Specialty: Special-purpose systems, their mathematical support and organization of computational processes (no. 05.13.15)

Qualification: Engineer-researcher

Major: Scanning tunneling microscopy

Term: September 1984 – June 1990

School: Moscow State Technical University named after N. E. Bauman

Address: 2-ya Baumanskaya St., bldg. 5, Moscow, 107005, Russian Federation

Faculty: Radio Electronics and Lasers

Department: Laser and Optoelectronic Systems

Course: Undergraduate and graduate

Specialty: Optical and optoelectronic systems (no. 19.10)

Degree: Master of science

Qualification: Optical engineer

Major: Scientific instruments
