

Igor V. Roshchin

Curriculum Vitæ et Studiorum

DEGREES

- **Ph.D.** in Physics, **2000**, University of Illinois at Urbana-Champaign
- **M.S.** in Physics, **1999**, University of Illinois at Urbana-Champaign
- **M.S.** (Cum laude) in Physics, **1993**, Moscow Institute of Physics and Technology (MIPT)
- **Diploma (BS)** (with distinction) Physics **1993**, Moscow Institute of Physics and Technology

AWARDS AND HONORS

- ICAM/NSF Fellowship for Junior Scientists for EINC (2013)
- Texas A&M University award “High Impact Practices in Undergraduate Education” (2011)
- John D. and Catherine T. MacArthur Fellowship (1994)
- Award of Excellence in Research, Moscow Physical Society, Russia (1993)
- Moscow Mayor Fellowship (1991-1992)

EMPLOYMENT

2016 – present	Senior Technology Consultant (stealth mode startups).
2015 – present	Chief Communication Expert, ComEffic.
2014 – 2017	Research Scientist, Texas A&M University.
2008 – 2014	Assistant Professor, Texas A&M University.
2007 – 2008	Visiting Researcher, University of California – San Diego, CA
2001 – 2007	Research Scientist, University of California – San Diego, CA
2000 – 2001	Research Scientist, New York University, NY
1994 – 1999	John D. and Catherine T. MacArthur Fellow and Research Assistant, University of Illinois at Urbana-Champaign, IL
1995 – 1996	Teaching Assistant, University of Illinois at Urbana-Champaign, IL
1990 – 1993	Researcher, General Physics Institute of Russian Academy of Sciences, Moscow, Russia
1990 – 1992	Teacher, MIPT Physical-Technical Correspondence School, Moscow, Russia

PATENTS

- “Exchange-bias based multi-state magnetic memory and logic devices and magnetically stabilized magnetic storage” (US Patent, 7,764,454, July 27, 2010).
- Frequency mixer having ferromagnetic film” (US patent, 9,300,251, Mar 29, 2016)

PUBLICATIONS: 44 (36 in refereed journals) and over **70** conference presentations

INVITED TALKS: 67

EXPERTISE

- Leadership and management of interdisciplinary research groups, research facilities.
- Ability to communicate complex scientific and technical concepts to diverse audiences.
- Condensed matter physics, materials analysis, and nanotechnology, focusing on experimental aspects of novel materials, nanostructures, and highly correlated electron systems.
- Inter- and multidisciplinary (mat. sci./physics/chemistry/electrical engineering) materials analysis & characterization of materials, surfaces, novel micro- and nano-electronic devices, and sensors.

- Electrochemical processing, thin film and multi-layer growth, self-assembly, micro and nano-fabrication lithography techniques.
- Magnetism, superconductivity, multifunctional materials.
- Physical, chemical and biological sensors.

TECHNIQUES FOR MATERIALS CHARACTERIZATION AND FABRICATION

- Materials characterization: AFM/EFM/MFM, surface profilometry, RBS, Raman, ellipsometry, electronic transport, MR, Kerr effect and SQUID magnetometry, X-ray and neutron diffractometry and reflectometry, electron microscopy (SEM, TEM) and spectroscopy (XPS, AES, SIMS, EDS).
- Anodization; plasma, ion-beam and wet etch; UV and e-beam lithography, self-assembly.
- Thin film/multilayer growth (PVD/CVD): sputter-deposition, e-beam and thermal evaporation, MBE.

RESEARCH SERVICE AND PROFESSIONAL MEMBERSHIP

- Topic Area Organizer/Program Committee member, Intermag-2018. [major magnetism conference, 1000+ participants; review of over 100 submitted and invited talks, in charge of 2 topical sessions.]
- Topic Area Organizer/Program Committee member, Intermag-2017. [major magnetism conference, 1000+ participants; review of over 100 submitted and invited talks, in charge of 2 topical sessions.]
- Topic Area Organizer/Program Committee member, Joint 12th MMM-Intermag Conference (2011-2012). [major magnetism conference, 2000+ participants; review of over 200 submitted and invited talks, in charge of 6 topical sessions.]
- Organizer of TAMU – CINVESTAV (Mexico) workshop “Materials Across The Border”, July 2009 (with T. Cagin and R. Arroyave).
- Session Chair at MMM, Joint MMM/Intermag conferences [includes choosing manuscript reviewers and organizing review of manuscripts], and APS March Meetings.
- Referee for Physical Review Letters, Physical Review B, Applied Physics Letters, IEEE Transactions on Magnetics, IEEE Transactions on Nanotechnology, J. of Magnetism and Magnetic Materials, ACS Nano, J. of Applied Physics.
- Textbook Review for Pearson Education.
- Grant proposal reviewer for
 - US-DOE SBIR-STTR,
 - FONDECYT (Chile),
 - CONACIT (Chile),
 - Hercules Foundation (Belgium),
 - International Research Travel Assistance Grant (IRTAG)
 - AMU-CONACyT Collaborative Research Grant Program (TAMU).
- Member: American Physical Society, Materials Research Society, IEEE, IEEE Magnetics Society, IEEE Nanotechnology Council.

APPOINTMENTS AND SERVICES, INCLUDING OUTREACH

- MSEN program graduate admission committee, TAMU, 2010 – 2014.
- Department of Physics and Astronomy faculty IT committee, TAMU, 2010 – 2014.
- M.S. and Ph.D. dissertation committees in the departments of Physics and Astronomy, Chemistry, Materials Science and Engineering, Mechanical Engineering at Texas A&M Univ.

- Ad-hoc Committee Work: Development of Plan of Improvement of student recruitment for the MSEN program, TAMU (2012)
- Panel meeting with ADVANCE Roadmap Workshop participants (enhancing diversity of women STEM faculty), March 2012
- Consulting Pearson Education on development of Mastering Physics platform (2009, 2012)
- Preparation of Physics Challenge Exam for Mechanics Scholar Competition (2009, 2012)
- Physics and Engineering Festival, TAMU, 2013
- Big Physics Day at Texas A&M University, 2010
- Chemistry Open House and Science Exploration Gallery, 2008-2009
- Presentations at the Department of Physics and Astronomy graduate student orientations at TAMU (2008-2010)
- Panel “Preparing Future Physics Faculty” for UCSD physics graduate students, 2006
- Open house tours for prospective graduate students, UCSD, 2005-2006
- Instrumentation facility manager
- Laboratory Safety Officer, UCSD 2001-2008
- Co-Chair, Chair, European Staff Association, UCSD, 2003-2006, 2006-2008
- Graduate Admissions Committee, Department of Physics, UIUC, consultant, 1996
- Departmental Academic Advisory Board, MITP, appointed by the Head of the Department of Physics and Energy Problems in 1993
- Open house for prospective students, MITP, 1988-1990

PROFESSIONAL EXPERIENCE

2016 – present **Technology Consultant:**

Consulting on scientific, technical and management issues.

- Worked with clients’ R&D teams to solve scientific and technical challenges.
- Trained clients on advanced materials analysis methods.

2015 – present **Chief Communication Specialist, ComEffic:**

Development and delivery of workshops on effective communication.

- Developed and taught workshops on effective communication for scientists, engineers, project managers, and governmental employees.

2014 – 2017 **Research Scientist/Visiting Research Scientist, Texas A&M University:**

Interdisciplinary research on shape memory alloys.

- Discovered the role of secondary heat treatment on martensitic transformation arrest in NiCoMnIn

2008 – 2014 **Assistant Professor, Department of Physics and Astronomy, Department of Materials Science and Engineering, and Materials Science and Engineering program, Texas A&M University:**

Research on magnetic nanostructures and multilayers at nanoscale and anodization-based fabrication techniques.

- Built and managed “Thin Film and Nanostructures” research laboratory with close to \$1M of infrastructure and instrumentation. Worked on building infrastructure and instrumentation design with the architect, mechanical & electrical engineers and vendors.
- Established and managed AFM facility; trained users.
- Led a research group (10 people) working on experimental nanoscale magnetism.
- Led collaborative research projects with scientific groups in the US, Mexico, Chile, Spain.

Studies of magnetic nanostructures and multilayers at nanoscale; magnetic proximity effects, including exchange bias

- Discovered new magnetic ordering in thin-films of nominally antiferromagnetic materials.
- Discovered “intrinsic” exchange bias (in antiferromagnet-only structures).
- Observed unusual effect of nonmagnetic layers (Cu) on magnetic properties (exchange bias).
- Formulated classification of exchange bias systems into two big classes – explains long term puzzle about differences in observed exchange bias properties.
High-sensitivity magnetometry and Polarized Neutron Scattering measurements of thin antiferromagnetic films.
XRD structural characterization of thin films.
Fabrication of macroscopic masks with 10-100 nm pores by aluminum anodization. AFM imaging.
Micromagnetic simulation.

Studies of magnetic shape memory/Huesler alloys

- Developed method to characterize morphology of magnetic shape memory alloys using FORC.
Heat treatment and magnetometry of magnetic shape memory alloys (MSMA).
Pioneering application of First Order Reversal Curves (FORC) to characterization of these alloys.
Studies of exchange bias in MSMA.

2001 – 2007 Research Scientist, UCSD

**2007 – 2008 Visiting Research Scientist, UCSD
(with group of Prof. I. K. Schuller):**

Studies of magnetic nanodots and exchange bias at nanoscale

- Experimentally observed vortex to single domain transition in Fe 30–100 nm nanodots.
- Measured vortex core out-of-plane magnetization and size in 65 nm nanodots with polarized Small Angle Neutron Scattering.
- Demonstrated stabilization of Fe nanodot magnetization with exchange bias.
Studies of magnetic nanodots by various techniques (SQUID, MOKE magnetometry, FMR, MFM, etc.).
Fabrication of macroscopic masks with 10-100 nm self-assembled pores in anodized alumina.
Fabrication of macroscopic (>1cm²) arrays of sub-100 nm magnetic dots.
Micromagnetic simulations for nanodot structures.
Studies of exchange bias in nanostructured magnets.

Studies of exchange bias in thin films and magnetic multi-layers

- Demonstrated imprinting magnetic domains from a ferromagnet into an antiferromagnet in exchange-biased systems.
- Discovered relevance of relative lateral length scales in exchange-bias.
Fabrication and magnetic and structural studies of magnetic thin films and multi-layers.
- Established depth profile of magnetic spins in exchange bias bilayers.
- Discovered slow dynamics in exchange bias systems.

Anodization-based materials/device fabrication.

- Adapted and improved anodization-based nanoporous alumina fabrication for lithography mask, devices and sensors.
AFM and SEM characterization of the masks, devices, sensors. Image analysis using *ImageJ*.

Capillary condensation in nanopores

- Experimentally confirmed Kelvin equation in capillary condensation in nanoporous alumina.
- Experimentally confirmed Cohan model.
Studies of capillary condensation in alumina nanopores (optical interferometry).

Nanostructures and devices for biomedical applications

- Developed device concept and methods used for targeted drug delivery.

- Developed device concept and methods used for controlled drug release.
Studies of liquid condensation and evaporation in nanostructures.

Nanostructures and devices for intelligent sensors

- Demonstrated nanoporous alumina photonic crystal-based chemical and biological sensors.
Studies of photonic crystals-based sensors.
Label-free molecular biosensors based on thin film optical interferometry in porous thin films.
Fabrication of “Moth’s eye” silicon structures, using macroscopic masks with 100-200 nm self-assembled pores produced by alumina anodization.
Fabrication of nano-porous electrodes for metallophthalocyanine sensors, using 40-60 nm self-assembled pores produced by alumina anodization.

Studies of spin waves in thin film devices

- Experimentally observed spin wave propagation in thin film ferromagnetic spin-wave guide.
- Observed frequency conversion in a spin-wave guide.

Studies of magnetic tunnel junctions (MTJ)

- Demonstrated the origin of temperature dependence of TMR in MTJ’s. Improved the model of thermal smearing in MTJ’s.
Studies of field, temperature, barrier strength, and bias dependencies of electron tunneling characteristics in MTJ.

Supervision and training of junior researchers and facility users. Safety Officer

- Supervised multi-user experimental facility. Led all stages of selection, purchase, and installation of \$600k X-ray diffractometer and the infrastructure. Developed and delivered instrumentation training.
- Developed and implemented EH&S compliance plan.

2000 – 2001 Scientific consultant, TROG Corporation, Brooklyn, NY:

Development of new technology for continuous High- T_c superconductor round wires.

2000 – 2001 Research Scientist, NYU (with group of Prof. A. D. Kent):

Studies of magnetic and magneto-transport properties of ferromagnetic micro- and nanostructures

- Demonstrated control of magnetic domain configuration and trapping of domain walls in 40-100 nm-wide planar Fe point-contact.
Studies of ferromagnetic structures with sub-100 nm constrictions using AFM/MFM, magneto-optical Kerr effect, and magneto-transport measurements.
Fabrication of Fe thin film microstructures using photolithography (at Cornell NanoFab).
Nanopatterning with Focused Ion Beam.
Thin ferromagnetic films and multilayers fabrication.
AFM/EFM studies of magnetic tunnel junction barriers.

1994 – 1999 Research with Prof. L. H. Greene (Thesis advisor), UIUC: John D., Catherine T. MacArthur Fellow (1994)

Studies of the superconducting proximity effect in superconductor-semiconductor structures

- First to optically observe proximity effect at a semiconductor/superconductor interface.
Tunneling and Raman spectroscopy, SQUID magnetometry on Nb/InAs structures.
Fabrication of nano-structures on Nb/InAs using e-beam lithography.

Growth and studies of structural and electronic properties of thin-film superconductors

- Improved growth techniques to fabricate very high-quality superconducting Nb and NbN thin films on insulators and semiconductors.

Direct observation of the superconducting energy gap in conductivity spectra by microwave and far infrared measurements.

Studies of vortex rotation in thin Nb/Al bilayer films by neutron scattering.

Studies of InAs near-surface electronic structure modified by ion-etch induced damage and chemical treatment of the surface

- Developed a technique of surface passivation with self-assembled monolayers of alkanethiols, which preserves the near-surface electronic band structure of InAs.
Raman spectroscopy on InAs.

**1990 – 1993 Junior Researcher, General Physics Inst. of Russian Academy of Sciences,
(with Low Temperature Physics group of High Magnetic Field Division)**

Studies of bulk bicrystals of copperless oxide superconductors (BKBO, BPBO)

- Established anomalous behavior of the critical current of the bicrystals.
Transport and magnetic properties of bulk bicrystals of copperless oxide superconductors ($\text{BaPb}_{1-x}\text{Bi}_x\text{O}_3$, $\text{Ba}_{1-x}\text{KBi}_x\text{O}_3$). Josephson behavior of the grain boundaries of these bicrystals.
Magnetoresistance measurements of the specially doped semiconductor high magnetic field temperature sensors.

TEACHING EXPERIENCE AND RESEARCH ADVISING:

- 2008 – 2014 Assistant Professor, course instructor (Texas A&M University):
Phys-218: Introduction to Classical Mechanics for Engineers (2008-2012)
Phys-444: The Art of Communication in physics, Part 1 – Communicating Science to Scientists (2012-2014)
Phys-445: The Art of Communication in physics, Part 2 – Communicating Science to Nonscientists (2012-2014)
Phys-489 – Special topics: “The Art of Scientific Communication” – Parts 1 and 2. (Spring and Fall 2011)
Phys-485, and Phys-685 – Directed Studies,
Phys-491, and Phys-691 – Research
MSEN-602: Advanced Materials Science and Engineering (Spring 2013, 2014)
- 2011 – 2012 Development of brand-new courses (Texas A&M University):
- Phys-444: The Art of Communication in physics, 1 – Communicating Science to Scientists
Phys-445: The Art of Communication in physics, 2 – Communicating Science to Non-scientists
- 2008 UCSD, substitute lecturer for “Electricity and Magnetism” course for engineers
- 2007 Lecturer at the Ph.D. Summer School “Functional Materials”, Puhajarve, Estonia, June 2007
- 1995 – 2017 Supervise graduate, undergraduate, and high-school student research
- 1995 – 1996 UIUC, Teaching Asst. - mathematical methods in physics, boundary problems (graduate level course)
- 1989 – 1993, 1999 Guest lecturer for mathematical analysis and differential equations theory, and experimental condensed matter techniques undergraduate courses at several universities in Russia and USA
- 1990 – 1992 MIPT Physical-Technical Correspondence School, physics and mathematics teacher
- 1990 – 1993, 1995 Lecturer at semiannual Young Scientists Society schools, Chelyabinsk and Krasnoyarsk (Russia)
- 1987 – 1993 Organizer of physics and mathematics Olympiads for high-school students

AWARDS AND HONORS OF STUDENTS (AT TAMU)

- Leonardo Bello Puentes, Best Presentation Award, Texas Section APS (October 2013)
- Leonardo Bello Puentes, Texas Section APS Student Travel Award (October 2013)
- Pavel N. Lapa, Texas Section APS Student Travel Award (October 2013)
- Pavel N. Lapa, APS GMAG Student Travel Award (March 2013)
- Pavel N. Lapa, Texas Section APS Student Travel Award (October 2012)
- Dogan Kaya, OGS Graduate Student Presentation Award (February 2012)
- Andrew King, Undergraduate Honors Thesis. TAMU (2012)
- Andrew King, APS “Future of Physics Days” Student Award (February 2012)
- Dogan Kaya, Texas Section APS Student Travel Award (October 2011)
- Andrew King, Texas Section APS Student Travel Award (October 2011)
- Alison Pawlicki, 2011 National Science Foundation (NSF) Graduate Research Fellowship Program (GRFP) Fellowship
- Karie Badgely, “Susan M. Arseven’75 Make-A-Difference Memorial Award” (2011)
- Jacob Gonzales, Undergraduate Honors Thesis. TAMU (2010)
- H. Ponce, Best Poster Presentation, Second Chile-Mexico Workshop, Cocoyoc, Morelos, Mexico, (January 5-8, 2010)

STUDENTS SUPERVISED: (underlined names – TAMU period)

Graduate students:

2011 – 2017	<u>Pavel N. Lapa</u> (Ph.D. in Physics, TAMU; now at General Atomics)
2010 – 2012	<u>Dogan Kaya</u> (M.S. in Physics, TAMU; Cukurova University)
2010 – 2011	<u>Alison Pawlicki</u> (switched to Chemistry Department/MSEN, TAMU)
2009 – 2010	<u>Hugo Ponce</u> (M.S. in Mat. Science, at CINVESTAV, Mexico City since Aug. 2010)
2008 – 2011	<u>Karie E. Badgely</u> (M.S., now at Fermi Lab)
2007 – 2008	Mikhail Erekhinsky (Physics Department, UCSD, now at Taboola)
2006 – 2008	Casey E. Chiang (Chemistry Department, UCSD)
2007 – 2007	Miroslavna Kovylyna (visiting graduate student, Universitat de Barcelona, Spain)
2002 – 2007	Chang-Peng Li (now at Siemens)
2002 – 2006	Zhi-Pan Li (now at Sentieon Inc.):
2004 – 2004	Neil Bushong (summer research, UCSD, now at Verisk Financial)
2003 – 2004	Cornel Colesniuc (research project supervision, UCSD, now at Intel)

Undergraduate and exchange students:

2013 – 2014	<u>Leonardo Bello Puentes</u> (B.S. in Physics, TAMU, now at NVR, Inc.)
2012 – 2014	<u>Jordan Garrison</u> (Department of Physics and Astronomy, TAMU)
2010 – 2012	<u>Andrew King</u> (B.S. in Physics and Mathematics, at PTC since June 2012)
2009 – 2010	<u>Jacob Gonzales</u> (B.S. in Physics, at Capital One since June 2010)
2004 summer	Jeff Noel (REU-2004 student)
2001 – 2003	F. Vincent Cerimele (independent research; at ViaSat since 2007)
2001 – 2002	Doug Bird (independent research)
2001 summer	Nathan Greenblatt (REU-2001 student)
2000 – 2001	Valerie Gordeski (was Gorodetskaya) (now at Bluefin Robotics)
2000 – 2000	Takei Ko (engineering program student from Stevens Institute of Technology)
1998 – 1999	Matthew T. Dearing (visiting student from Illinois Wesleyan, now at Argonne Nat. Lab.)
1997 – 1998	William L. Murphy (visiting student from Illinois Wesleyan, now at U. Wisconsin)
1995 – 1996	Gregory Kuchler (exchange student from Regensburg, now at Siemens)

LIST OF PUBLICATIONS AND PRESENTATIONS - [AVAILABLE VIA THIS LINK](#)