# Irina Sharai

*Research Scientist, PhD in Physics*

***Curriculum Vitae***

## Personal Data and Contacts


Birth date 1978, December 2

Nationality Ukrainian

Family Married, 2 child

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## Background and objectives

My field of expertise is magnetism of nanostructures and devices. Currently my research is focused on designing magnetic nanostructures with new functionalities promising for applica-tions in spin-electronics. This requires extensive use of the state-of-the-art nanofabrication methods (deposition of ultra-thin-film multilayers, photo- and electron-beam lithography, focused ion beam) and sensitive experimental characterization techniques (VSM and Kerr magnetometry, magneto-transport measurements, ferromagnetic resonance, etc.). Some of my recent results are demonstration of temperature-dependent indirect (RKKY) and di-rect exchange interactions in transition-metal magnetic multilayers, aimed at novel thermo-magnetic applications in thermionics and magnetocalorics. I am also active in spin dynamics in magnetic multilayers, which incorporate conventional and synthetic ferro-, ferri- and an-tiferromagnet materials. I have had a leading role in the above projects contributing to the entire effort, from generating ideas to material or device fabrication, measurements, analysis, and publication. The most fascinating part to me is brainstorming new ideas and their experimental implementation, which requires constant learning of new techniques and methods as well as communication with other experts in the field worldwide.

## Education

1996–2002 Specialist of Science in hysics, *National Technical University of Ukraine "Kyiv Politechnic Institute" (www.kpi.ua), The Faculty of Physics and Mathematics, Kyiv, Ukraine.*
*Specialization: Physics.*
*Specialist thesis title: Hydrolized silicon oxide thin films optical studies*

2009–2012 **PhD in Physics**, *Institute of Magnetism, NAS of Ukraine and MES of Ukraine*, Kyiv, Ukraine.

**PhD thesis title:** *Influence of structural inhomogeneities on the surface of the magnetic films on their magnetic and optical properties.*

**Description:** The thesis is devoted to the study of influence of structural inhomogeneities on the surface of the magnetic films on their magnetic and optical properties. In particular, the investigations of ultra-thin magnetic films layers of bismuth-substituted ferrite garnets and one-dimensional magnetophotonic crystals were performed. It was found that a high-energy ion treatment of substrates surface leads to the formation of a transitional layer on the boundary between substrate and film with a smooth change of composition that enables to control the magnitude of magneto-optical effects in such films. This changes the compensation point of the magnetic sample, as well as magnitude and sign of magneto-optical effect. It was experimentally demonstrated that the effectiveness of recrystallization and the roughness of NiFe films surface when irradiated by nanosecond laser pulses depends on the laser radiation wavelength. For the first time, the method of managing of high-frequency magnetic susceptibility of magnetic nanoparticles by using an external constant magnetic field for their heating by an alternating magnetic field was developed. It was shown that varying the magnitude and direction of the constant magnetic field, we can change the values of high-frequency magnetic susceptibility by dozen times. The phenomenon of nonlinear dependence of magnetic permeability on the magnetic field was proposed to use for the creation of high-sensitive compact flux-gate magnetic field sensors with parametric amplification of signals. The methods of creation of high-gradient magnetic fields with a given configuration using structured substrates were proposed.

## Professional Experience

2010–pres. **Senior Research Scientist (2016-present), Research Scientist (2012-2016), Engineer (2010-2012)**, *Institute of Magnetism, NASU*, Kyiv, Ukraine.

- Ferromagnetic resonance of complex-oxide magnetic materials (bulk composites and thin films) and transition-metal nanostructures (multilayers, arrays of nanowires, etc.).
- Spin-transport, resonance and magneto-electric experiments in complex-oxide and multi-ferroic hetero-structures.
- Phenomenological simulations: ferromagnetic resonance in thin films and multilayers; temperature-dependent hysteresis loops of nanoparticle ensembles.

2015–2018 **Postdoctoral researcher, Parental leave (May 2017 - Feb. 2018)**, *Royal Institute of Technology KTH*, Stockholm, Sweden.

- Spin-thermionics and magnetocalorics in multilayers and nanodevices.
- Engineering of temperature-controlled indirect and direct exchange interaction in magnetic multilayers.
- Nanofabrication: magnetron sputtering, lithography.
- Experimental characterization: vibrating-sample and magneto-optic magnetometry, magneto-transport measurements, ferromagnetic resonance.

2012–2014 **Teacher of Physics**, *Secondary School*, Kyiv, Ukraine.

## Awards

2014 Prize of the President of Ukraine for young scientists.

2013 Participation Grant of FP7 Nanotwinning project to take part in the 2nd International Summer School for young scientists "NANO-2013" (*Bukovel, Ukraine*).

2012–2013 Fellowship of Zavtra.UA scholarship program for talented students by the Victor Pinchuk foundation.

2012 Diploma for the best oral report among young scientists at the International conference "CMMT-2012" (*Kyiv, Ukraine*).

## Primary Scientific and Technical Interests

- Magnetism of nanoscaled systems; spintronics.
- Spin dynamics in magnetic nanostructures.
- Spin-thermionic and magnetocaloric properties of transition-metal nanostructures.
- Nanofabrication methods: thin film deposition, lithography.
- Characterization techniques: magnetic-resonance and spin-transport measurements.

## Skills and Techniques

- ***Magnetic characterization:*** Ferromagnetic resonance, magneto-transport measurements, VSM magnetometry, magneto-optical Kerr-effect (MOKE) magnetometry (polarization modulation, PEM).
- ***Nanofabrication:*** Magnetron sputtering (incl. reactive and co-deposition), optical and electron-beam lithography, cryogenic mechanical and reactive etching, etc.
- ***Morphological characterization:*** SEM/FIB microscopy, atomic (magnetic) force microscopy, etc.
- ***Computer simulations:*** Phenomenological calculations of ferromagnetic resonance and magnetic hysteresis, finite element method simulations, etc.

## Participation in International projects

2014–2017 Spin-thermo-electronics, *Science and Technology Center in Ukraine (STCU)*.

2013–2014 Nanostructured left-handed media and magnetotunable elements on their basis for applications in EHF band, *STCU*.

## Publications and Conferences

### 20 published papers (7 papers in 2017) & 17 conference presentations

### Selected papers:

- D. M. Polishchuk, Yu. O. Tykhonenko-Polishchuk, E. Holmgren, A. F. Kravets, and V. Korenivski, *Thermally induced antiferromagnetic exchange in magnetic multilayers*, Phys. Rev. B **96**, 104427 (2017).
- D. M. Polishchuk, Yu. O. Tykhonenko-Polishchuk, A. F. Kravets, and V. Korenivski, *Thermal switching of indirect interlayer exchange in magnetic multilayers*, EPL **118**, 37006 (2017).
- A. F. Kravets, D. M. Polishchuk, V. A. Pashchenko, A. I. Tovstolytkin, V. Korenivski, *Current-driven thermo-magnetic switching in magnetic tunnel junctions*, Appl. Phys. Lett. **111**, 262401 (2017).
- A. F. Kravets, D. M. Polishchuk, Yu. I. Dzhezherya, A. I. Tovstolytkin, V. O. Golub, and V. Korenivski, *Anisotropic magnetization relaxation in ferromagnetic multilayers with variable interlayer exchange coupling*, Phys. Rev. B **94**, 064429 (2016).
- A. F. Kravets, A. I. Tovstolytkin, Yu. I. Dzhezherya, D. M. Polishchuk, I. M. Kozak, and V. Korenivski, *Spin dynamics in a Curie-switch*, J. Phys.: Condens. Matter. **27**, 446003 (2015).
- S. K. Arora, B. J. O'Dowd, D. M. Polishchuk, A. I. Tovstolytkin, P. Thakur, N. B. Brookes, B. Ballesteros, P. Gambardella, and I. V. Shvets, *Observation of out-of-plane unidirectional anisotropy in MgO-capped planar nanowire arrays of Fe*, J. Appl. Phys. **114**, 133903 (2013).

- D. M. Polishchuk, A. I. Tovstolytkin, E. Fertman, V. Desnenko, A. Beznosov, M. Kajnakova, A. Feher, *Structural first-order transformation in $La_{2/3}Ba_{1/3}MnO_3$: ESR study,* J. Magn. Magn. Mater. **324**, 4225 (2012).

## Computer skills

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|---|---|
| Languages | Wolfram Mathematica, Python |
| OS | Windows |
| Tools | LabView, OriginPro, Adobe Photoshop & Illustrator, MS Office, LaTeX |

## Languages

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| Ukrainian | Fluent | *My first native language.* |
| Russian | Fluent | *My second native language.* |
| English | Fluent | *Used for work, publications and presentations.* |

## Interests

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| Popular science | Sustainable development, astrophysics, etc. |
| Photography | Landscape, nature. |
| Sport | Football, tennis, bicycle. |

Dmytro Polishchuk *May 18, 2018*