



# Proposals

for cooperation

of Department of Physics of Metals  
and Semiconductors of NTU "KhPI"



**The head of the Department: Sergei Malykhin, Professor,  
Doctor of Physics and Mathematics**

**e-mail: [malykhin@kpi.kharkov.ua](mailto:malykhin@kpi.kharkov.ua)**

**Teaching staff:**

**Professor, D. Sc. – 3 persons;**

**Assistant professor, PhD – 4 persons.**

**Research staff:**

**Leading researcher, D. Sc. – 5 persons;**

**Senior researcher, PhD – 11 persons;**

**Researcher – 7 persons;**

**Post-graduate – 4 persons.**

**The training is conducting in specialty “Materials science “.**

**Academic degrees on graduating at university:**

**Bachelor of Engineering materials science;**

**Master`s degree, Physical materials science, professional in  
the field of materials science.**

## Research fields at the present time:

- Quantitative analysis of polyphase systems and nanomaterials using X-Ray fluorescence method in wide range of elements (starting with hydrogen) and concentration (including “trace” elements).
- Development and investigation of new multilayer nanostructures for X-Ray mirrors and nanotribology.
- Investigation of structure and properties evolution taking place in solid materials under high intensity factors influence (bombardment by high-energy electrons, protons, ions, irradiation of high-power plasma stream, thermal field and strong mechanical contact loadings in wide temperature range).
- Optical investigation and spectroscopy of biocompatible materials (oxide coatings, carbon films).
- Investigation of structure and physical properties of quasicrystals (Ti-Zr-Ni, Ti-Hf-Ni)
- Investigation of growth regularities and structure of chalcogenide semiconductors.
- Development of characterization methods for magnetic multilayer nanostructures with granular layers.
- Development of flux gates based on multilayer nanostructures for registration of weak magnetic field ( $10^{-10} - 10^{-12}$  T).
- Theoretical investigation of quantum single-electron current source.

# Scientific activities:

## Recent papers:

1. I.E.Gakusha, N.N.Aksenov, O.V.Byrka, V.A.Makhlai, S.S.Herashchenko, S.V.Malykhin, Yu.V.Petrov, V.V.Staltsov, S.V.Surovitskiy, M.Wirtz, J.Linke, M.J.Sadowski, E.Skladnik-Sadowska Simulation of plasma-surface interactions in a fusion reactor by means of QSPA plasma streams: recent results and prospects // *Physica Scripta*. –2016.- v.91.- p.094001 (10pp).
2. N.V.Krainyukova, E.N.Zubarev Carbon honeycomb high capacity storage for gaseous and liquid species // *Phys. Rev. Lett.* - 2016. – v.116 – p.055501.
3. I. Mikhailov, A.Baturin, V.Kondratenko, I.Kopilets, A.Mikhailov Prospects for application of X-ray anomalous transmission effect to monochromatization of broadband spectrum // *Journal of X-Ray Science and Technology* – 2016. - pp.1-8 (in press).
4. O.V. Penkov, A.Y. Devizenko, M. Khadem, E.N. Zubarev, D.E. Kim, V.V.Kondratenko Toward Zero Micro/Macro-Scale Wear Using Periodic Nano-Layered Coatings.// *ACS Applied Materials & Interfaces*- 2015 . -V.7. -P. 18136-18144.
5. A.A. Korneev, Y.P. Korneeva, M.Yu. Mikhailov, Y.P. Pershin, A.V. Semenov, D.Yu. Vodolazov, A.V. Divochiy, Y.B. Vakhtomin, K.V. Smirnov, A.G. Sivakov, A.Yu. Devizenko, G.N. Goltsman. Characterization of MoSi Superconducting Single-Photon Detectors in the Magnetic Field // *IEEE transactions on applied superconductivity*- 2015.-V.25, N.3. -P. 2200504.
6. I.E. Garkusha, V. A. Makhlaj, N. N. Aksenov, O. V. Byrka, S. V. Malykhin, A. T.Pugachov, B. Bazylev, I. Landman, G. Pinsuk, J. Linke, M. Wirtz, M. J. Sadowski, E.Skladnik-Sadowska. High power plasma interaction with tungsten grades in ITER relevant conditions // *Journal of Physics: Conference Series* – 2915. – 591.- p.012030-012041.
7. O.V.Penkov, V.E.Pukha, S.L.Starikova, M.Khadem, V.V.Starikov, M.V.Maleev, D.-E.Kim Highly wear-resistant and biocompatible carbon nanocomposite coatings for dental implants // *Biomaterials*. –2016.-V.102.- N9.- p.130-136.
8. S.V. Bazdyreva, S. S. Borisova, S.V. Malykhin, A.T. Pugachov, A. M. Bovda, S. D. Lavrinenko, V. V. Abraimov, V. A. Lototskaja. Structure and substructure variations of icosahedral  $Ti_{41.5}Zr_{41.5}Ni_{17}$  quasicrystals under irradiation imitating outer space factors // *Functional Materials*, -2015.- V.22, No3. - p.304-308.
9. Khair, A., Eibelhuber, M., Volobuev, V., Witzan, M., Hochreiner, A., Groiss, H., &Springholz, G. Vertical external cavity surface emitting PbTe/CdTe quantum dot lasers for the mid-infrared spectral region // *Optics Letters*.-2014. -39(23), 6577-6580. doi: 10.1364/OL.39.006577.
10. I.Shipkova, Ju.Chekrygina, A.Devizenko, E.Lebedeva, N.Syr'ev, S.Vyzulin, Magnetic and Magnetoresponse Studies of Composite Multilayer Films with Different Kinds of Interlayers // *Solid State Phenomena*. - 2015.- V.233-234. - p.633-636.
11. M. Moskalets. Floquet Scattering Matrix Theory of HeatFluctuations in Dynamical Quantum Conductors // *Phys.Rev. Lett.*- 2014.- V.112.- P. 206801 (5). <http://journals.aps.org/prl/abstract/10.1103/PhysRevLett.112.206801>.
12. F. Battista, M. Moskalets, M. Albert, and P. Samuelsson. Quantum heat fluctuations of singleparticle sources // *Phys.Rev. Lett.*- 2013.- V.110, N12.- P.126602(5). <http://journals.aps.org/prl/abstract/10.1103/PhysRevLett.110.126602>.

## Joint projects:

- CRDF project № UKP-7074-KK-12 (2013 –2015) 74.8, Sipatov O.Yu.
- Sipatov O.Yu., Project on “Semiconductor nanostructures”, Institutes of Physics, Polish Academy of Sciences, Warsaw.
- In the frame of EUROfusion Consortium Programme the nonfinancial investigations have been carried on in the field of fusion energy in cooperation with Jülich Research Centre (Germany), Karlsruhe Institute of Technology (Germany), National Centre for Nuclear Research, Otwock (Poland).

## Patents of Ukraine:

1. І.Ф. Михайлов, О.А. Батурін, А.І. Михайлов. Спосіб визначення вмісту вуглецю в сталі. Патент на корисну модель № 98040 від 10.04.2015. (I.F.Mikhailov, O.A.Baturin, A.I. Mikhailov. Method of carbon concentration defining in steel. Utility model patent № 98040 від 10.04.2015).
2. І.Ф. Михайлов, О.А. Батурін, В.В. Кондратенко, І.А. Копилець, Ю. П. Першин. Пристрій монохроматизації рентгенівського випромінювання ширококутового джерела. Патент на корисну модель № 101988 від 12.10 2015.(I.F.Mikhailov, O.A.Baturin, V.V.Kondratenko, I.A.Kopilets, Y.P. Pershin. Device for monochromatization of broadband X-Ray radiation source. Utility model patent № 101988 від 12.10 2015).

# Proposal for joint research:

## Project “Materials and coatings for application in biology and medicine”

### The aims of Project:

- to work out the methods of investigation of implant surface;
- to develop the preparation technique of bioactive coatings meant for regeneration and growth of bone tissue;
- to study electrochemical processes taking place at contact of inorganic material with biological tissues;
- to study influence of magnetic field on human organism and other biosystems.



### Scientific novelty:

We intend to carry out pioneer precise research of electric and magnetic field influence on functioning and growth stimulation of living tissues.

### Significance for practice:

Results obtained will be used at developing new type of coatings for medical implants. These coatings promote to decreasing adaptation period and acceleration of wound repair.

## Methods of measurement:

Electron microscopy, X-Ray analysis, optical spectroscopy in the range of 1200-186 nm, infrared spectroscopy in the interval of  $7800\text{-}350\text{ cm}^{-1}$ , measuring of electric and magnetic properties by appropriate standard and original equipment.



In order to make the experimental information more exact we would like to cooperate with research groups of Institute of Experimental Physics of Faculty of Natural Science which known for their investigations in the field of physics and biology.