# Proposal

of Department of Physics of Metals and Semiconductors of NTU “KhPI” for the cooperation

*The head of the Department*:

***Sergei Malykhin, Professor, Doctor of Physics and Mathematics***

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*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***.

Recognized scientific school

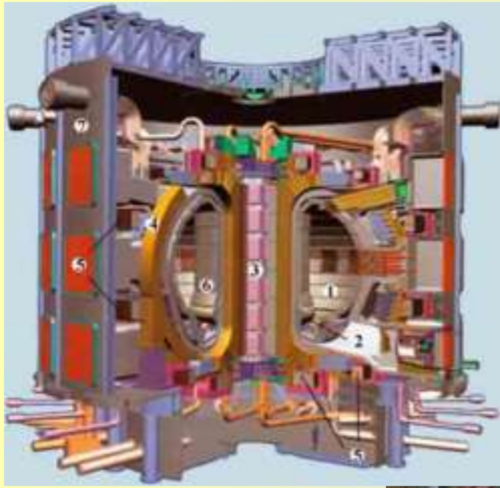
# "Physics of Thin Films and Physical Materials Science"

**Founder of the school: Professor L.S. Palatnik**

Investigation of the structure and physical properties, the formation mechanisms of film and other nano-scale objects, phase transformations in condensed systems, the behavior of materials in extreme conditions of space, nuclear and thermonuclear reactors.

Development of the physical foundations for technologies of new materials with unique properties (nanocrystalline objects, films and film compositions, fullerenes, ceramics, biomaterials, quasi-crystals, artificial diamonds, superhard materials, etc.).

Development of methods, equipment and components for the study of the composition and structural state of materials.



# ITER W-divertor


- **Materials in extreme environment**
(tungsten, RAFM steels, different alloys etc.)
- **Surface modification effects by ion and plasma irradiation**
- **Thin films, protective coatings, quasi-crystals**
- **Structural analysis**

The changes of

- **structure,**
- **residual stresses,**
- **substructure (coherence length and average micro-strains) ,**
- **complexes of point defects**

within surface layers induced by plasma exposures

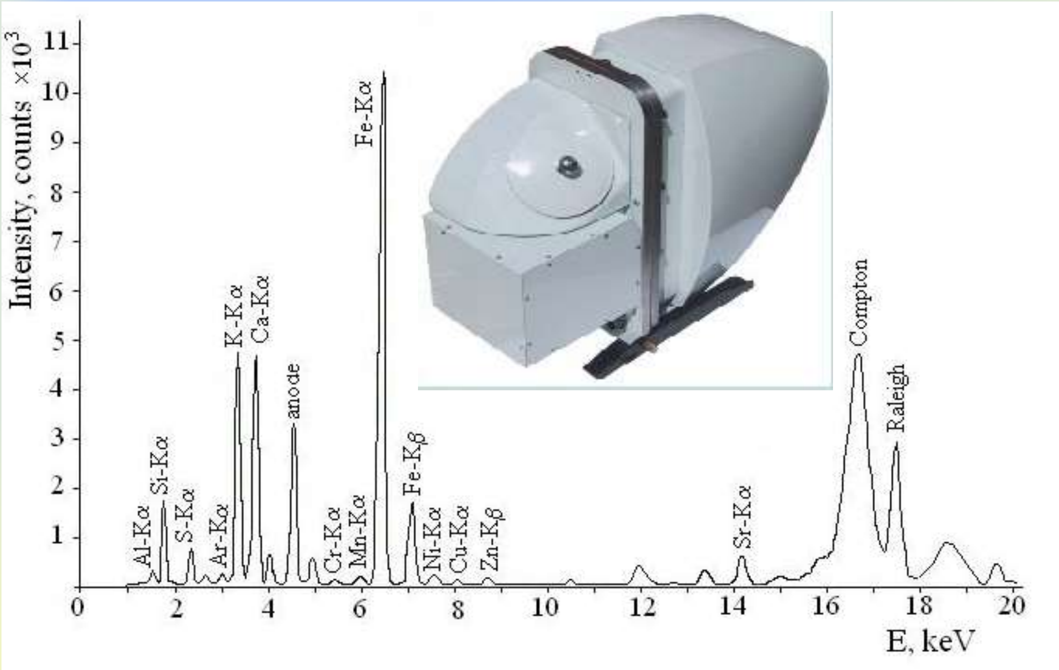
***References:***

1. *Makhlaj V.A., Malykhin S.V. et al.* Residual Stresses in Tungsten under Exposures with ITER ELM-Like Plasma Loads. *Phys. Scr. 2009. v. 138, 014060.*
2. *Garkusha I.E. , Malykhin S.V., et al. Changes in the structure and substructure of tungsten during irradiation by hydrogen plasma flows at the specific energy close to the heat loads on the ITER surface. Technical Physics, 2014, V. 59, 11, 1620.*
3. *Bazdyreva S.V., Makhlaj V.A., Malykhin S.V., Pugachov A.T. Relationship between development of cracks, changes of substructure and strains state of tungsten irradiated by plasma heat loads relevant to ITER transient events . PAST 2014 V.6, 48*

# Rapid Method for Determination of Ash Content in Coal

**Prof. I.Mikhailov**

The product may be applied for rapid determination of, for example, coal ash, in the areas of metal mining, energetic and metallurgy industries.



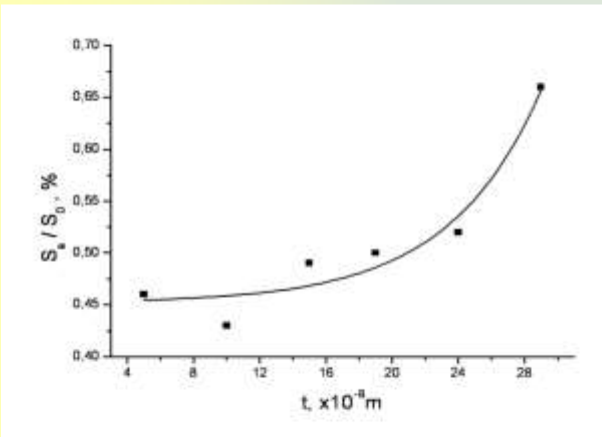

A sample is irradiated by a low-power (20 W) X-ray beam which involves several monochromatic lines. Fluorescence radiation of chemical elements contained in the sample is registered simultaneously with Compton and Rayleigh scattered monochromatic radiation. Ash mass fraction is determined by Compton-to-Rayleigh peak ratio taking into account iron fluorescence intensity. For measuring the ash mass fraction, the calibration with standards is used.

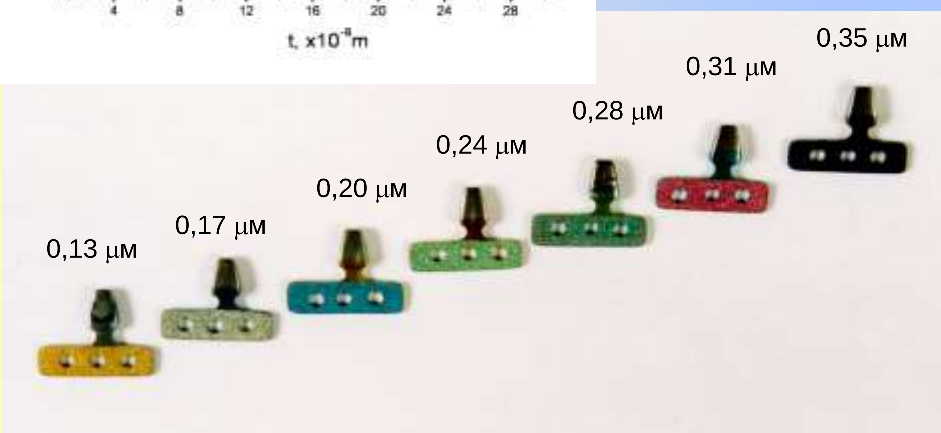
The instrument requires neither water cooling, nor vacuuming; its overall dimensions are 400×150×600 mm. Reliable functioning is provided by high quality components (Amptek, USA) in basic units (tube, detector, power supply unit). The cost of the instrument is $50,000.

# Metal-oxide coating with electret properties for medical implants

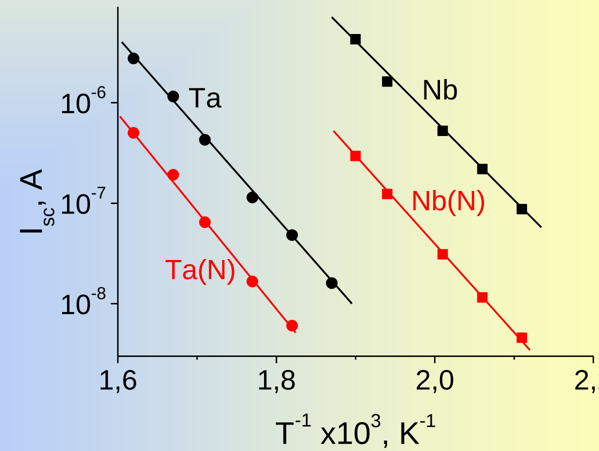
Dental endoossal and subperiosteal implants with electret coatings

Dependence of electret charge on oxide thickness




Stabilization of the oxide composition and properties




The interaction of electret coating with the inorganic components of blood plasma activates the formation of calcium phosphate (and subsequently hydroxyapatite crystals) near implant surface that leads to increase in the bond strength of oxidized metal and bone by 20%.

Fedorenko A.I., Starikov V.V., Pozdeev Yu.L., Lykov I.N. Layer systems on the base of nitrogen-doped tantalum and niobium with enhanced stability// Cryst. Res. Technol. - 1997. - Vol. 32. - No .6. - P. 843-848.

Kutsevlyak V.I., Starikova S.L., Starikov V.V., Mamalis A.G., Lavrynenko S.N., Ramsden J.J. Influence of implant surface modification on integration with bone tissue// Journal of Biological Physics and Chemistry. - 2008. - Vol. 8. - P. 147-150.

Starikov V.V., Starikova S.L., Mamalis A.G., Lavrynenko S.N. Features of medical implant passivation using anodic oxide films// Journal of Biological Physics and Chemistry. - 2016. - Vol. 16. - No. 2. - P. 90-94.

# Multilayer X-ray optics elements

**Prof. V.Kondratenko**

Scientific areas:
- -Structure and optics characteristic of multilayer mirrors
- -Thermal and radiation stability of multilayer mirrors
- -Soft X-ray microscopy based on multilayer mirrors

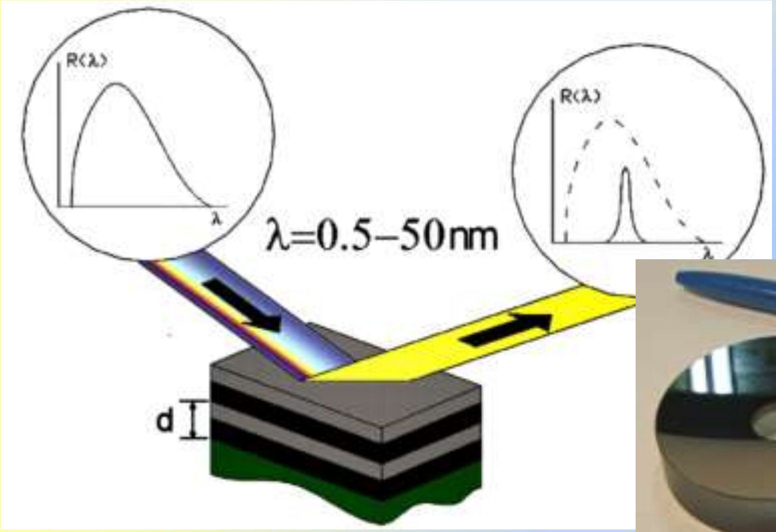



Fig. Reflectivity of X-ray by multilayer mirror

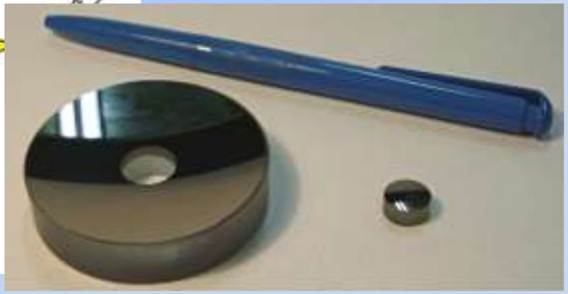


Fig. X-ray multilayer mirrors

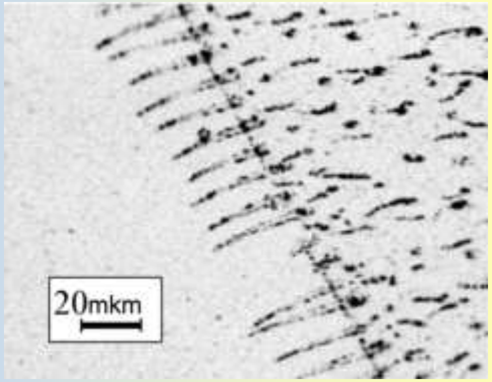



Fig. Fly (Sarcophaga carnaria L.) wingtip in soft X-ray


1.High-reflectivity multilayer mirrors for a vacuum-ultraviolet interval of 35–50nm. Optics letters, V.23, N.10, p. 771-773 (1998)
2.Interlayer transition zones in Mo/Si superlattices. Journal of Applied Physics, V.92, N.3, p.1216-1220(2002)
3.Carbon window soft x-ray imaging using multilayer optics /Proc. SPIE. V.5919. p. 59190E (2005)