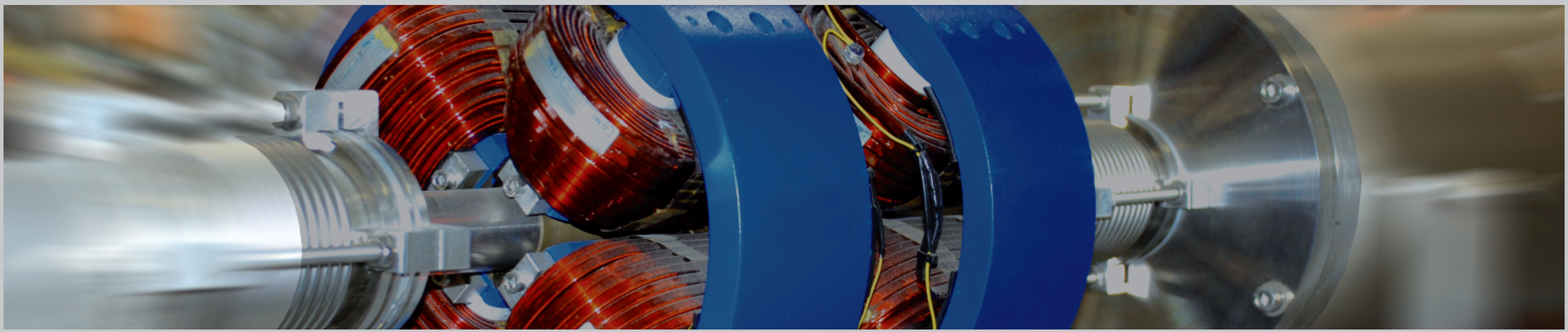


science | research | innovation

STU
MTF

UNIVERSITY SCIENTIFIC PARK | CAMBO

Signing the contract © STU 2013

Prof. Ing. Róbert Redhammer, PhD . – Rector of the Slovak University of Technology in Bratislava

"... Establishment of the University Science Park will provide better conditions for the top research, university education and effective co-operation with the entrepreneurial environment. The Slovak University of Technology has achieved very good results in the field of science and innovative research. We also have experience with the support in starting-up companies and spinning-off enterprises; yet we desperately lack investment. Currently, we are eliminating this deficiency and I therefore believe that if reinforcing infrastructure, our effort will bring substantially bigger long-term economic and social benefit to Slovakia."

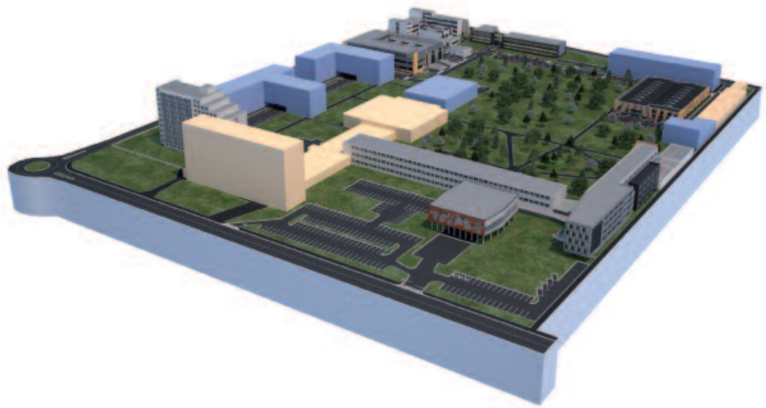
Dušan Čaplovič – Minister of Education, Science and Sport of the Slovak Republic

"... A modern knowledge society is an inevitable pre-requisite of democratic development, scientific and technological progress, economic growth, social welfare and higher employment rate. The chances of Slovakia in these areas are great. If the country takes this unique challenge, its society will start changing substantially. Forming the relations between science and development, mutual partnership between entrepreneurial sphere and academic environment is essential for our integration into the common European educational, research and development, innovative and entrepreneurial space."

Dr.h.c. Prof. Dr. Ing. Oliver Moravčík – The Faculty of Materials Science and Technology in Trnava

"It is a remarkable success for the Faculty, STU, and Slovakia; we have made a fundamental step towards increasing the impact of science and technology on the development of Slovakia and its competitiveness within the EU."

UNIVERSITY SCIENTIFIC PARK



STU MTF
UNIVERSITY SCIENTIFIC PARK | CAMBO

Visualisation of CAMBO © Coproject 2013

Established in 1937, the Slovak University of Technology in Bratislava is the oldest technical university in Slovakia with the residence in Bratislava. Currently, it comprises seven faculties. STU MTF located in Trnava is one of them.

The University Scientific Park is primarily focused on Materials Engineering in the field of ion and plasma technologies, automation and ICT implementation in industrial processes. The project comprises of two new buildings for the purposes of research, located on the Bottova campus.
Within the project, STU MTF will build two new research centres equipped with the most advanced technologies for the following specific activities:

1/ Scientific centre of materials research with laboratories, comprised of the:
Laboratory of ion beam technologies
Laboratory of plasmatic modification and deposition
Laboratory of analytical methods
Laboratory of computational modelling.

2/ Scientific centre of automation and ICT implementation in production processes and related laboratories, comprised of the:
Laboratory of control systems
Laboratory of ICIM
Laboratory of information integration and control systems.

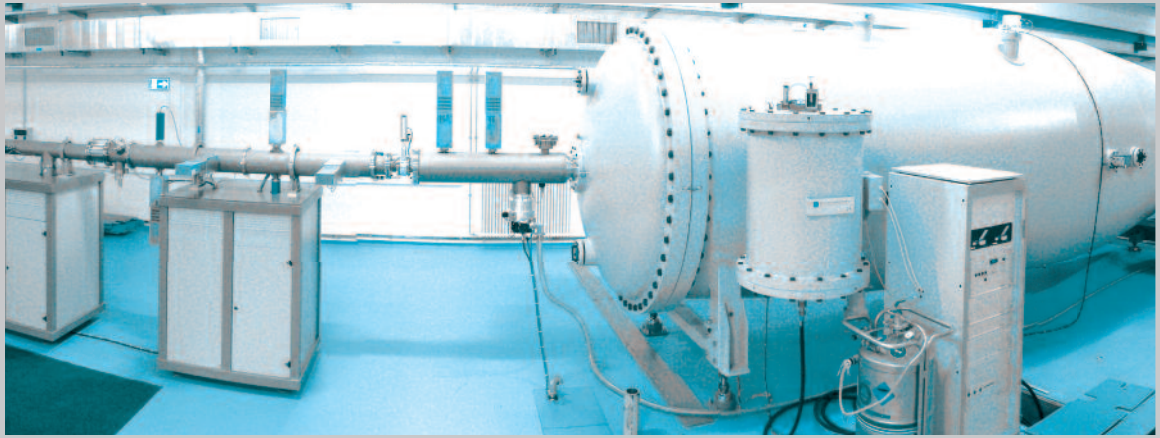
Besides creating the two new workplaces and purchasing unique technologies for materials research and research in the field of automation and ICT implementation in production processes and the related laboratories, the further planned activities are:

3/ Applied research in the above-men tioned research centres

4/ Support to transfer the advanced technologies into practice, transfer of know-how, innovations and knowledge from the academic environment into practice and pro viding support for start-up and spin-off activities.

CENTRE OF MATERIALS RESEARCH – SLOVAKION

STU
UNIVERSITY SCIENTIFIC PARK
Centre of Materials Research – Slovakion



6MV Tandetron used for high-energy ion implantation and irradiation © HZDR Dresden

Aims of the Centre

Research infrastructures are major instruments, installations, or facilities that provide high-tech services to support the work of researchers.

The aim of Centre of Materials Research – Slovakion is the integration of high-end ion technologies into STU research facility. The activities of the centre will be equally utilised for purpose of both in-house and external research and in a wide scale of services oriented on the support in research, development and technology transfer of new materials, nanostructures, surface functions using plasma and ion technologies into production processes for external industrial and other users in a broad range of applications.

Centre of Materials Research – Slovakion will carry out basic and applied research in the areas of materials science as well as modofication and analysis of solid surfaces using ion beams.

The effect of ion bombardment on the generation and modification of thin films is studied experimentally and by using computer simulation. In addition to the relationships between structure and properties, the research will be focused on various possible applications.

An important component of the research and development of new thin film systems is the use of low-energy ions and the use of pulsed plasma for generating metastable phases, high film densities, extraordinary adhesion of films, nanostructures or special textures.

A closed cooperation and interaction with industrial partners is focused on the technology transfer of modern ion technologies and the development of high-tech equipment in the field.

Typical high voltage cascade of an accelerator © HZDR Dresden

Ion Technologies

Ion technologies make use of charged atoms accelerated to high velocities ranging from about 500 km/s to 50.000 km/s, which corresponds to kinetic energies of roughly 10 keV to 100 MeV.

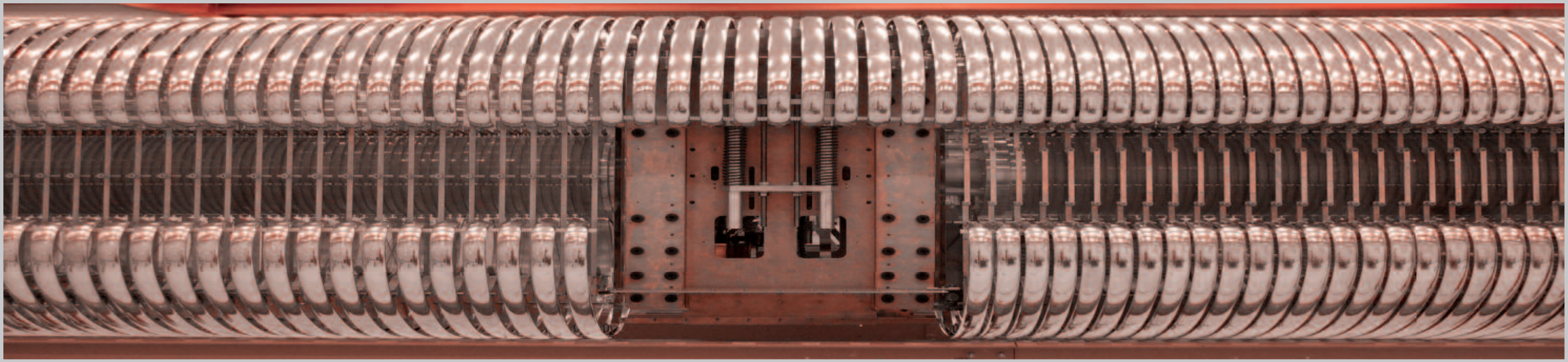
Owing to their high momentum, such ions penetrate through the surface of materials, and are thus able to probe or to modify the surface into a depth which is determined by the ion energy.

Ion Beam Surface Interaction

Ion irradiation of materials results in a number of basic phenomena. When a fast ion hits an atom of the material, it may be backscattered with a small probably, or generate a fast recoil atom. Further, the ion may initiate a nuclear reaction which emits particle or gamma radiation, or, by the interaction with inner-shell electrons, characteristic X-rays may be emitted. The detection and spectroscopy of these primary or secondary particles or radiation may be utilized for compositional analysis of the subsurface layer. By successive interaction with the atoms and the electrons of the material, the ions are slowed down and finally come to rest. This introduces foreign atoms and may, at sufficiently high concentration of the implants, change the chemical composition of the material. The collisions of the ions with the target atoms may generate numerous recoil atoms, which in turn act in a way similar to the ion and excite further generations of recoil atoms. After thermalization of these cascades, a structural modification of the material may remain, as, e.g., crystalline disorder in a solid, broken bonds in polymers or biological cells. Finally, recoil atoms may leave the surface (“sputtering”) so that the latter is eroded under continous irradiation. Thus, by using either a focused beam or a broad beam with standard lithography techniques, the surface can be structured.

The physics of all these phenomena is well-established so that ion technologies can be applied in a very controlled way.

CENTRE OF MATERIALS RESEARCH – SLOVAKION



Inside a tandem accelerator © HZDR Dresden

Ion implantation

Ion implantation is a method to impact impurity atoms by accelerated ions into a base material or to generate defects in the material. In this way, the properties of the base material can be modified. In principle all chemical elements can be implanted (radioactive isotopes included).

Substrate materials include metals, alloys, semiconductors, ceramics and polymers. Implantation of radioactive isotopes and the subsequent 2D-detection of the emitted channeled electrons, enables the accurate determination of the lattice location of impurities in single crystalline materials.

- All chemical elements incl. radioisotopes can be implanted
- Surface property improvement for tribology, chemical stability & biocompability
- Development of electronical and optical Devices

Ion irradiation

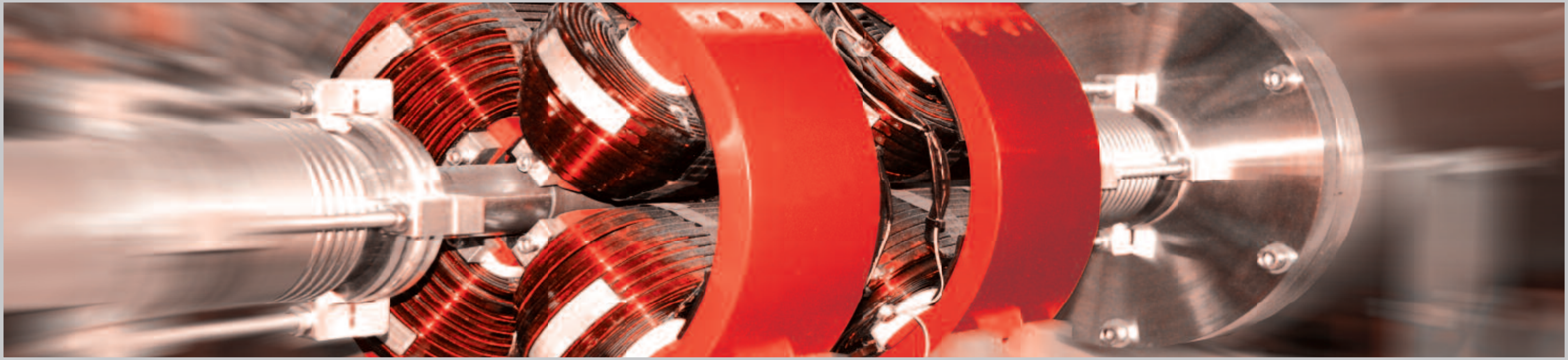
- Surface patterning
- Ion beam mixing at interfaces
- Radiation damage simulation
- Biological samples

Plasma immersion ion implantation

For practical purposes, the productivity of beam-line ion implantation is often limited in particular when high ion fluences on larger areas are required. In addition, the treatment of three-dimensional items requires mechanical manipulation. These problems can be overcome by direct plasma-based ion implantation.

By applying a pulsed bias voltage to the sample, ions are extracted from a large volume low-pressure plasma and accelerated towards the surface. Compared to beam-line implantation, the technique compromises with respect to beam contamination, and delivers a broader energy distribution of the ions.

Ion Implantation



Beam line with quadrupole lenses © HZDR Dresden

Ion lithography

- Prototyping and repair of nanostructures
- Nanoscale samples for process diagnostics
- Deep micro-structuring of photo-sensitive Materials

Equipment

Centre of Materials Research – Slovakion will use a wide pool of ion implanting machines with maximum acceleration voltages of

- 6 MV
- 500 kV
- 40 kV
- 20 kV

Fields of application

Biomaterials

- Nanoporous biomaterials
- Tribological protective layers
- Antibacterial surfaces
- Biocompatible surfaces
- Barrier layers

Super hard material layers

- Cubic boron nitride
- Titanium nitride

Nitriding

- Stainless steel
- Aluminium

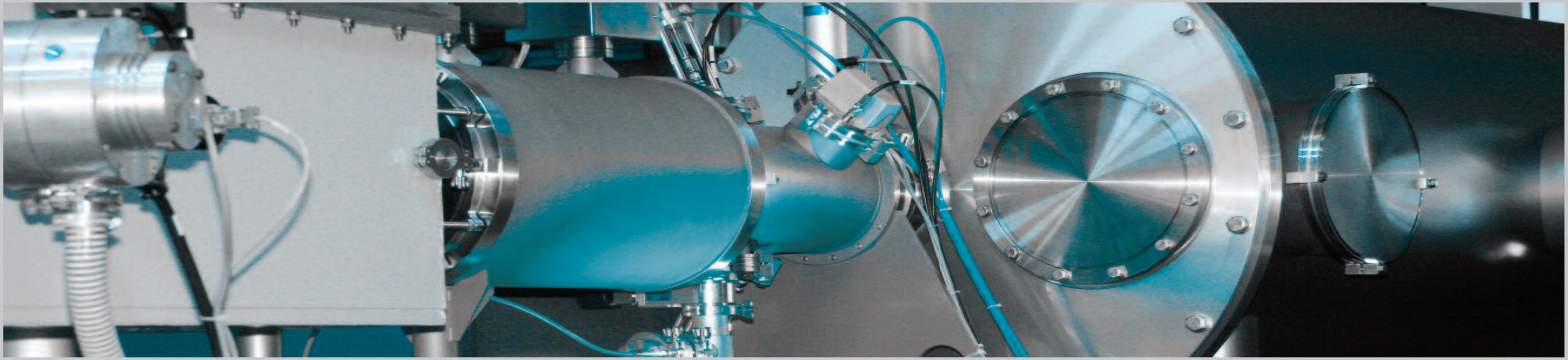
Surface protection of titanium and TiAl alloys

- High temperature oxidation protection of TiAl
- Protection against embrittlement of Ti
- Protective coatings for TiAl

Nanostructuring

- Nanoporous surface structures of metals
- Nanoporous polymer membrane filter
- Surface template structures

CENTRE OF MATERIALS RESEARCH – SLOVAKION



Typical ion beam lines of an accelerator lab © HZDR Dresden

Ion Beam Analysis

Basic principle of IBA

A high-energy ion beam (typically at energies between 1 MeV and 100 MeV) is directed to the surface to be analyzed. Through the interaction with the target atoms, the ions may be backscattered, generate energetic recoil atoms or characteristic X-rays, or may also trigger nuclear reactions. Using suitable detectors, the energy spectroscopy of the emitted particles or photons provides information on the species of the target atom.

In addition, the incident ions as well as emitted particles loose energy on their passage through the material. Then, again energy spectroscopy may be used to identify the depth at which the interaction took place, so that depth profiles can be obtained.

Compositional analysis

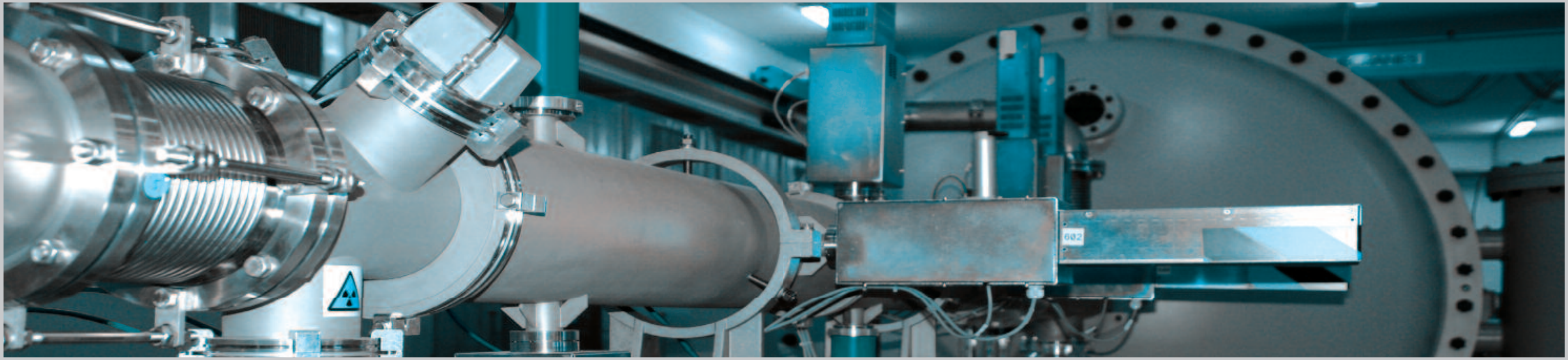
The elemental composition of thin films and surface-near layers can be determined quantitatively without the need for standards. In general, IBA results are free from any matrix effects. IBA is non-destructive in the sense that the sample is not eroded – nevertheless, there may be analyzing beam effects which influence the results in sensitive materials and which can be minimized by certain experimental means.

Typical detection limits between roughly 100 and 10.000 ppm (depending on the specific method) are sufficient for many applications.

Unique features of IBA

IBA can be applied to the lightest elements, in particular isotopes of hydrogen, helium, and lithium. IBA delivers quantitative depth profiles of the elemental composition, without eroding the sample surface. Correspondingly, any distortion of the depth profiles by the analyzing procedure is minimized. The depth resolution of IBA is mostly limited to between several nanometres and about one micrometer, depending on the specific IBA process. However, special devices enhance the depth resolution near the surface down to one atomic distance.

Ion Beam Analysis



Typical ion beam lines of an accelerator lab © HZDR Dresden

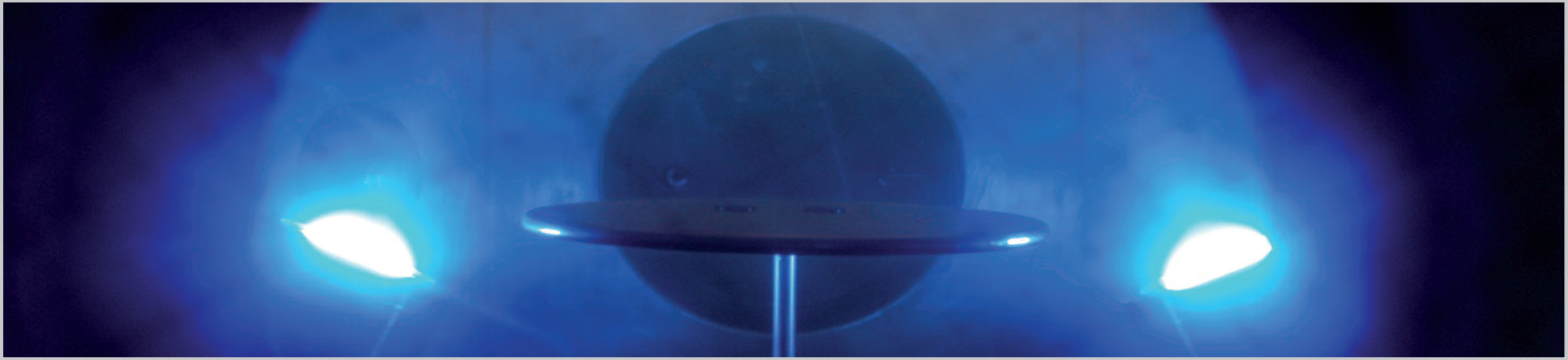
What IBA cannot deliver
Any information on the chemical binding state is generally not provided. IBA is not generically suited for structural analysis. However, in connection with the channeling effect, specific structural issues like lattice damage or lattice positions of foreign atoms may be investigated.

Analysis area
Standard setups employ beam spots sizes in the mm range. Microbeam devices deliver beam diameters of a few micrometer (standard) down to well below 100 nm.

Methods
- Rutherford backscattering spectrometry
- Nuclear recoil spectrometry
- Nuclear resonance reaction analysis
- Proton-induced X-ray and gamma-ray spectroscopy

Goals
- Chemical and structural analysis of thin films, layers and surfaces
- Non-destructive analysis of the art and cultural heritage objects
- In-situ analysis of atomic transport processes / in-situ ion beam analysis
- Depth profiling of any element

CENTRE OF MATERIALS RESEARCH – SLOVAKION



Metal plasma of an ion assisted deposition process © HZDR Dresden

Ion Beam Assisted Deposition

Modern thin film deposition processes using ion assistance play an important role in the improvement of film adhesion, film density, phase formation, low temperature deposition, film stress, texture, film morphology, hardness and many other film properties.

The basic equipment for plasma and ion beam assisted deposition processes of the Centre of Materials Research – Slovakion is focused on:

- Reactive and non-reactive Ion Beam Assisted Deposition (IBAD) instrumentation with different low energy ion sources;
- Universalmagnetronsputteringapplication systems with reactive pulsed dual magne tron sputtering or biased RF magnetron sputter processes and the possibility of in-situ plasma diagnostics and thin layers di agnostics.
- Combination of plasma immersion ion implantation and deposition processes (PBII & D) with ion energies up to 40keV

The main advantage of metal plasma based ion implantation and deposition (MePBII&D) compared to conventional thin film deposition technologies is the athermal energy deposition by the accelerated ions, causing an atomic mixing of the interface zone. Thus, excellent adhesion is achieved even at room temperature.

Ion Assisted Deposition

Plasma based ion implantation process © HZDR Dresden

Analogous to ion beam assisted deposition, textured thin films are obtained for MePBII&D. By varying the pulse voltage and the pulse length different film orientations can be achieved. Despite a columnar growth mode with column diameters between 50 and 500 nm, compact, dense and pore-free thin films are obtained.

Equipment and technology:

- Inductively coupled RF discharge produces mainly plasma of gaseous ions
- Magnetrons or arc produce a mixture of gaseous and metal ions and neutrals
- Magnetrons can change metal-ion to metal-neutral ratio depending on operation conditions
- Use of noble gases allows metal ion implantation and/or subsequent metal deposition assisted by noble gas ion implantation
- Use of oxygen or nitrogen allows formation of oxide and nitride films with high adhesion by high energy ion assistance.

Magnetrons above the PBII sample holder provide a high deposition rate of metal, oxide or nitride films, At the start of deposition magnetrons should work in HPIMSM mode generating a dense plasma needed for the creation of an mixed interface layer by PBII ion assistance for good film adhesion. After that the magnetrons should work in normal mean-power high duty cycle mode with high deposition rate.

CENTRE OF AUTOMATION AND INFORMATIZATION

STU
UNIVERSITY SCIENTIFIC PARK | Centre of Automation and Informatization

Visualisation of Centre © Coprojekt 2013

The scientific workplace of **Automation and ICT Implementation of Production Pro - cesses and Systems**, as a flexible system of automated technological control and pro - duction systems will enable the optimisation of the technological and production process es depending on the real needs of the entre preneurial practice.

Laboratories of the Centre:

LABORATORY OF CONTROL SYSTEMS

The Laboratory of control systems represents the lowest management level of production and technological processes.

It includes the collection and processing of technological process information, as well as the control of algorithms through programmable logic controllers and industrial controllers which are able to communicate with the master system at a higher level. Departments of the laboratory:

A/ Research workplace of complex processes

The workplace will comprise the following models and components:

- **Hybrid production system**

The physical model of a hybrid production system will combine the elements of process and factory automation, allowing the simulation of complex operations and processes.

- **Model of communicating vessels**

The equipment will consist of five identical laboratory models that will be used for simulation of technological processes in the field of process automation implementation and related experiments.

- **Supportive laboratory equipment LCS**

The equipment will consist of five identical laboratory stands which will be used for preparing the experiments, programming control systems and evaluating the results of experiments.

Automation and ICT Implementation of Production Processes and Systems

Laboratory of iCIM © Coprojekt 2013

B/ Research workplace of development and design of control systems

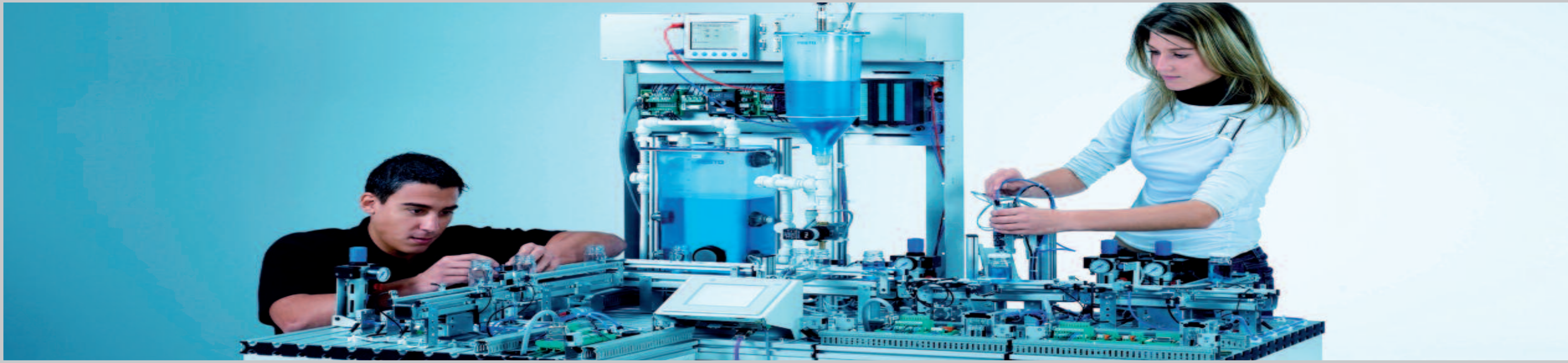
The system will contain software tools for computer-aided design and production documentation of automated control systems. Another part of the workplace will serve as a decentralised control system.

C/ Research workplace of simulation of technological processes

The workplace will comprise the software and models for:

- Multidomain simulation and model-oriented design for dynamic and embedded systems based on the interactive environment in collaboration with libraries and a customisable set of basic building blocks.
- Utilisation of commonly used algorithms in solving standard and large optimisation tasks based on the use of linear programming functions, quadratic programming, binary integer programming, nonlinear optimisation, nonlinear least squares, non-linear system of equations and multi-objective optimisation.
- Improved search for global solutions for problems containing multiple extremes.
- Design, implementation, visualisation and simulation of neural networks, where the use of a formal analysis would be difficult of impossible, such as pattern recognition or identification and control of nonlinear systems.
- Addressing and manipulating symbolic math expressions and performing calculations of variable accuracy. Together with module 1, it will allow tasks to be solved involving differentiation, integration, simplification, transformation and equations.
- Modelling and simulating of physical systems including mechanical, electrical, hydraulic and other physical domains.
- Simulation of three-dimensional mechanical systems such as robots, suspension vehicles, construction equipment and aircraft chassis.

CENTRE OF AUTOMATION AND INFORMATIZATION



A detail of the Laboratory of iCIM © Coprojekt 2013

LABORATORY OF iCIM

The specialised laboratory will cover technology and the visualisation level of corporate governance. The laboratory and its office will be connected not only with each other but also with the master system and the level of corporate governance. The laboratory designed in this way will provide space for research and development in a wide range of hardware, communication and management of automated software tools, knowledge-based systems, archiving and distribution of knowledge to higher-level systems.

The laboratory will comprise of the following research workplaces:

A/Research workplace of distributed control systems of production and technological processes

The workplace will contain the following models and components:

- **Modular production system**

The physical model of a modular production system will allow the simulation of complex operations and processes, which occur in the enterprises of automotive, engineering and electrical industries and will solve any tasks related to factory automation, as well as the related information technology.

- **CNC production system**

The physical model of CNC production system combining CNC lathe and CNC milling machine will be operated by industrial robots. The model will simulate, develop and explore fully automated production processes in the engineering industry and related information and communication technologies.

- **Supportive equipment of laboratory**

The equipment will consist of six identical laboratory stands used for the preparation of experiments, programming of the control systems, evaluation of the experiments' results and other associated activities relating to the laboratory performance.

Laboratory of control systems © Coprojekt 2013

B/Research workplace of logic and sequence control

The workplace will comprise the following models and components:

- System for logic and sequence control,
- System of frequency converters and induction motors,
- Optical system for optical detection and control of dimensional and shape accuracy,
- System for the autonomous carriagemovement in space,
- systemof robotcontrol.

LABORATORY OF THE INFORMATION AND CONTROL SYSTEMS INTEGRATION

The laboratory will serve as an integrated information system at the enterprise management level. Its core will comprise the following systems:

- System for production planning and control
- System of documents administration
- Tool for business intelligence
- Tool for knowledge discovery
- Tool for process mining
- Simulator of production processes and logistic systems with the optimisation option
- System of database management/control
- Laboratory equipment

A project component is the implementation providing mutual collaboration and interconnection of individual laboratory modules and integration between the system for production planning and control and system of documents administration.

CENTRE OF EXCELLENCE FOR FIVE-AXIS MACHINING

STU
UNIVERSITY SCIENTIFIC PARK
Centre of Excellence for Five-Axis Machining

The building of the Centre © STU MTF 2013

Basic characteristics
The establishment of the new Centre of Excellence and its sustainability will support the advanced technologies of five-axis machining, their research, HSC CNC milling and turning of free-form surfaces, CNC ultrasonic and laser machining of so-called hard-to-machine materials, and utilising CA technologies within CAD/CAM/CNC/CAQ.

The project aim is to enhance the machinery pool of the Centre of Excellence of five-axis machining, through the addition of machine tools and robots in the workplace of CNC HSC HIGH-Technologies of machining.

Another goal is to build a basic device pool in the workplace for measurement and control within the Centre of Excellence of five-axis machining, in order to support and implement the common research with CNC HSC HIGH–Technologies of Machining in the following fields: methods and strategies of five-axis machining on 5-axis machine tools of two different constructions, CNC laser machining, CNC grinding of free-form tools, 3D scanning of free-form parts, 3D control of forms and shapes of free-form tools, exact measurements of the cutting fluids' quality, measuring the inorganic and organic carbon, measuring the cutting forces in milling and turning (both in workpiece and tool), liquidating the bacteria by Ozonised, and finally balancing the cutting tools.

Centre of Excellence for Five-Axis Machining

Equipment in the Centre © Milan Marônek 2013

Centre of Excellence for five-axis machining workplaces:

WORKPLACE OF CNC HSC HIGH-TECHNOLOGIES FOR FIVE-AXIS MACHINING:

Machines of the Excellence Centre of 5-axis machining:

- DMG HSC 105 Linear
- DMG Ultrasonic20
- DMG CTX ALPHA 500
- CNC HSC 5-axis milling machine, cradle construction (DMU 85 mono BLOCK)
- CNC 5-axis HSC laser machine tool with accessories (LASERTEC 80 SHAPE)
- CNC multi-axistool grinderwith accessories (REINECKERWZS 60)
- CNC multi- axis robot for laser machining with accessories
- CNC multi-axisrobot for milling with accessories
- CNC multi- axis robot for machining and handling the workplace with accessories

Equipment and devices of the Centre of Excellence for five-axis machining:

- ZOLLER GÉNIUS 3 measuring instrument
- ATOS SO 4M3D scanner
- HAIMER Tool Dynamic balancing instrument
- KISTLER rotational dynamometer
- KISTLER stationary dynamometer
- TOC Analyser
- Ozoniser

WORKPLACE OF CAD/CAM HIGH-TECHNOLOGY FIVE-AXIS MACHINING

Software of the workplace:

- PowerSHAPE CAD software
- PowerMILL CAM software
- ArtCAM CAD/CAM software
- CopyCAD CAD/CAQ software

CENTRE OF EXCELLENCE FOR FIVE-AXIS MACHINING

Equipment in the Centre © Milan Marônek 2013

Utilisation of the Centre of Excellence for five-axis machining for entrepreneurial practice:

In the field of research:

- Research into all strategies of 5-axis machining by setting up discontinuous and continuous CNC milling of shape surfaces
- Research into HSC CNC milling and turning
- Research into CNC ultrasonic and five-axis machining
- Research into machining of hard-to-machine materials
- Research into CNC laser machining
- Research into utilisation of CA technologies in CAD/CAM/CNC/CAQ
- Research into tool wear in machining
- Research into parameters of cutting process
- Research into parameters and properties of cutting fluids
- Research in the field of cutting fluids, so called MQL, DRY machining

In the field of education:

- Education in the field of NC programming
- Education in the field of CAD/CAM systems
- Education in the field of reverse engineering
- Organising workshops, conferences and seminars

In the field of consultancy:

- Consultancy in the field of CAD/CAM systems
- Consultancy in the field of developing an environmental-friendly approach to machining
- Consultancy in the field of process media
- Consultancy in the field of the production process optimisation

In the field of production:

- Production of zero series
- Production of prototypes, forms, artistic objects
- Measuring and evaluation
- Inspection of parameters and shape by using optical methods
- Generating, testing and adjusting the NC trajectories
- Reverse engineering – 3D scanning
- Design, manufacturing and optimisation of 3D models.

Equipment in the Centre © Milan Marônek 2013

In the field of services:

- Inspection of complexity and quality of 3D model part in CAD PowerSHAPE
- Generating NC programs from 3D models for control systems of Heidenhain iTNC 530, Heidenhain TURNPLU, Siemens 840D
- Inspection and simulation of the delivered NC programs
- Inspection and formation of 3D surfaces from the scanned data

Research cooperation of the Centre of Excellence for five-axis machining with important partners in the field of research and development:

Delcam PLC – U.K. Small Heath Business Park, Birmingham

The main purpose of the project is the research of CAM-CNC post-processors and their experimental verification on CNC HSC machines in Centre of Excellence for five-axis machining at STU.

Technical University of Cluj – Napoca, Romania, Faculty of Machine Building

The main purpose of the research project is to develop theoretical concepts of CAD-CAM-CNC for special globoid cams manufacture, and to experimentally verify these concepts in the Centre of Excellence for five-axis machining.

Scientific goals:

a) Research into the impact of Five-Axis CAM strategies on achieving dimensional accuracy and roughness of CNC machined surfaces – the globoid cams.
b) The transfer of the research results into the design of study programmes at both universities.

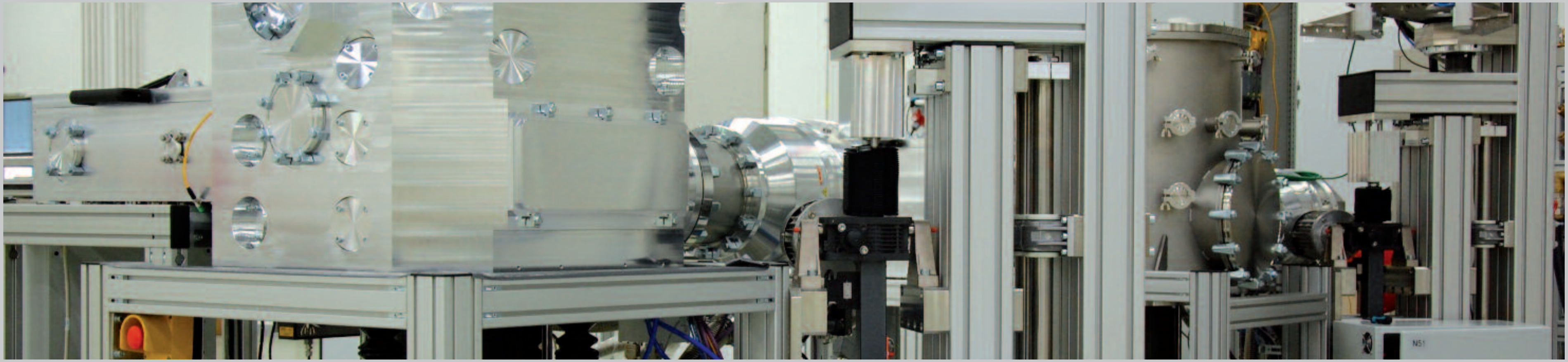
Kecskemét College, Hungary, Faculty of Mechanical Engineering and Automation

The main purpose of the research project is to develop theoretical concepts of monitoring the HSM of 5-axis machining and to experimentally verify these concepts in the Centre of Excellence for five-axis machining.

Partial goals of the project:

a) Research into the strategies of high speed monitoring of high speed machining in 5-axis machining.
b) Transfer of the achieved research results into the design of study programmes at both universities.

ADVANCED TECHNOLOGIES RESEARCH INSTITUTE (ATRI)



Advanced Technologies Research Institute (ATRI) is the first and main institute at the University Science Park (Faculty of Materials Science and Technology in Trnava, Slovak University of Technology in Bratislava), having a team of excelent researches, engineers, PhD candidates and junior researchers. The ATRI is focused on materials engineering in the field of ion beam and plasma technologies, physics, astrophysics, chemistry, automation and ICT implementation in industrial processes or research fields such as nanotechnology and nanostructures, sensorics, specific hardware & software development, bioengineering and health, big data, software engineering, calculations, simulation and modelling. The area of materials research includes theoretical modelling using ab-initio methods, either at very accurate level treating small systems at the molecular scale, or DFT methods concerning bulk materials and surfaces. The area of Automation and ICT implementation provides also space for research and development in a wide range of hardware, communication and management of automated software tools, knowledge-based systems, as well as archiving and distribution of knowledge to higher-level systems.

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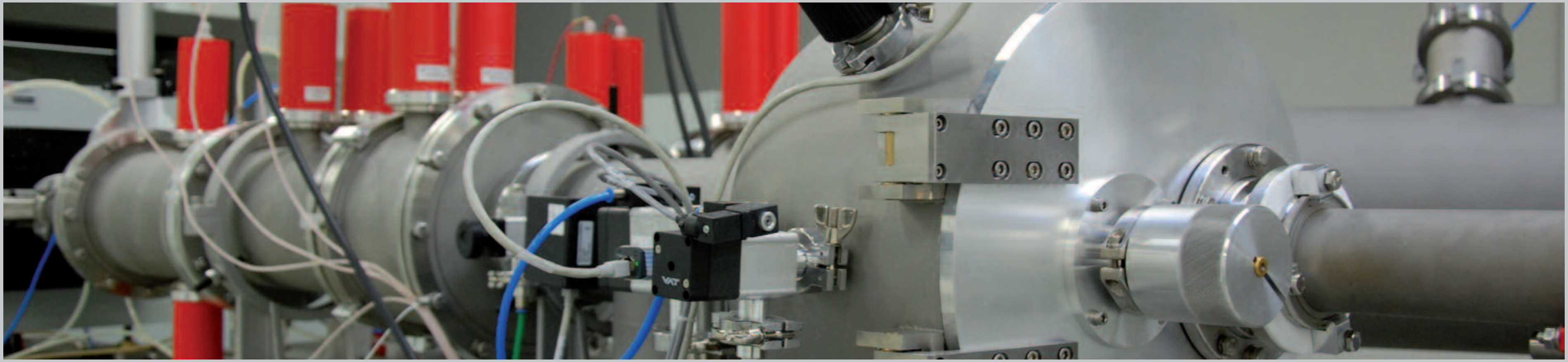
ATRI
Advanced Technologies
Research Institute



LABORATORY OF ION BEAM TECHNOLOGIES

Contact: pavol.noga@stuba.sk

- Ion beam technologies, plasmatic modification and deposition
- Analytical methods, computational modelling, physics, astrophysics and chemistry

Range of applicable ion energies and species ranging from 40keV up to 50 MeV for heavy ions and currents up to 2 mA for low energy beams and 50 µA for high energy beams. Ion sources enable working with virtually all elements of the Periodic Table

TECHNICAL EQUIPMENT

- 6MV Tandetron Tandem Accelerator
- Experimental end-station for ion implantation (wafer size up to Ø100 mm) with substrate temperature control (-195 °C to 800 °C)
- End-station for Ion Beam Analysis covering RBS, PIXE and ERD (hydrogen depth profiling)
- 500kV Implanter
- Experimental end-station for ion implantation (up to Ø100mm) with substrate temperature control
- Semi-automatic single wafer (up to Ø200 mm) processing end-station

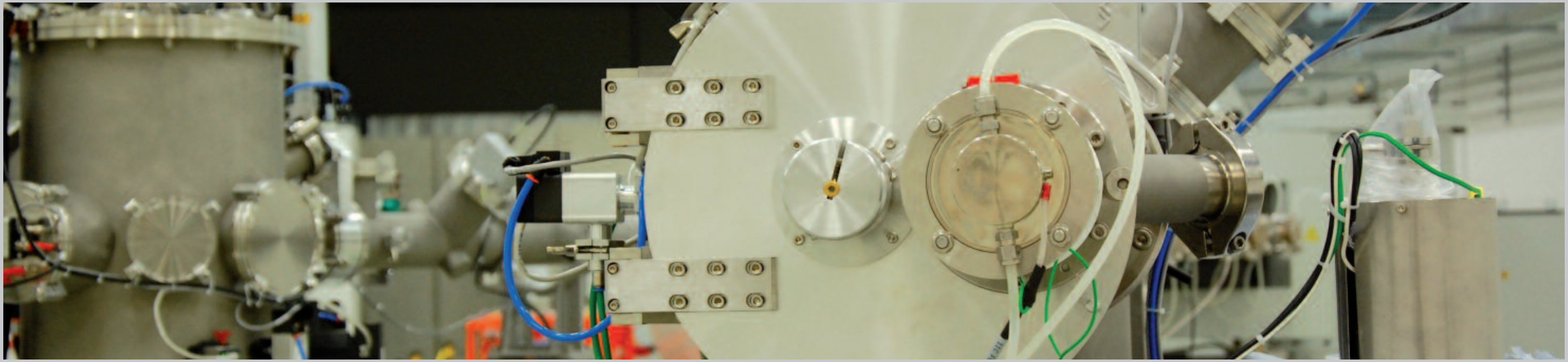
TECHNOLOGY

- Surface/thin layer modification
- Ion beam assisted material synthesis
- Ion beam analysis (RBS/Channeling, PIXE, ERD)
- Radiation damage studies

SERVICES

- Ion implantation of substrates up to Ø200mm
- High energy ion implantation of substrates up to Ø100mm
- Analysis of thin layers and surfaces
- Radiation hardness testing
- Consulting services in the field of ion beam applications

THE ATRI LABORATORIES



ION BEAM ANALYSIS LABORATORY
Contact: jozef.dobrovodsky@stuba.sk

Ion Beam Analysis (IBA) means analysis of surface layers of materials using the energetic ion beams. We work with ion beams in the energy range from 500 keV up to energy exceeding 10 MeV. The interaction of accelerated ions with atoms of hit sample leads to several physical phenomena. Depending on the layout and geometry of the experiment, and on which interaction product is detected, we can utilize a variety of ion beam based analytical methods. Depending on which component of the result of the interaction emitted from the sample is detected, we perform the following analytical methods:

- RBS - Rutherford Backscattering Spectrometry
- channeling or RBS/C
- ERDA - Elastic Recoil Detection Analysis
- PIXE - Particle Induced X-ray Emission
- NRA - Nuclear Reaction Analysis

LABORATORY OF PLASMATIC MODIFICATION AND DEPOSITION
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Understanding the complex plasma-surface processes involved in sputtering, etching, ion implantation and deposition at nanoscale level. Activities dedicated to investigation of plasma/surface interaction in technological plasmas

FIELDS OF INTEREST

- Automotive industry (low friction coatings for car engines with higher efficiency)
- Electronics (transparent conductive layers with improved optical and electrical properties)
- Machinery and Aerospace (coatings with higher wear resistance and thermal stability)
- Biomedicine (implants with improved biocompatibility)

TECHNICAL EQUIPMENT

- Magnetron sputtering /dc, rf (ZnO, $TiO2$, TiC, DLC coatings)
- Plasma Immersion Ion Implantation (surface protection of Ti and TiAl alloys, Biomedical – tribological protective coatings, antibacterial surfaces)

LABORATORY OF NUMERICAL MODELING

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THE CURRENT RESEARCH OF COVERS THE FOLLOWING TOPICS

- Development and applications of coupled cluster methods
- Ab initio calculations of metallic clusters properties
- Accurate calculations of molecular NMR properties including relativistic and solvent effects
- Potential energy surfaces for theoretical infrared spectroscopy, computational atmospheric chemistry
- Ab initio modelling of materials interface structure and its impact on the thermodynamic properties of nano-layers
- Fast stochastic variability (red noise) of accretion processes in the binary stars and active galactic nuclei
- Monte Carlo simulations of red noise and satellite observation data analysis from Kepler and XMM-Newton missions

The problems solved by the researchers in the frame of applied research for industry are e. g. development of computer application for numerical modelling of magnetic fields in the high reliability relays (Hengstler/Danaher) and design and optimization of high performance ultra-sound transducers (Kraintek). The Laboratory uses computational resources of HPC cluster of the Slovak University of Technology and Slovak Infrastructure for High Performance Computing.

PARTNERS

Institute of Astrophysics, Kyoto University, Japan; Institute of Organic Chemistry, Polish Academy of Sciences; EMPA, Swiss Federal Laboratories for Materials Science and Technology, Dubendorf, Switzerland; ESAC, European Space Agency, Madrid, Spain; Cadarache, Saint-Paul-lez-Durance, France; GSMA, Reims University Champagne-Ardenne, Reims, France

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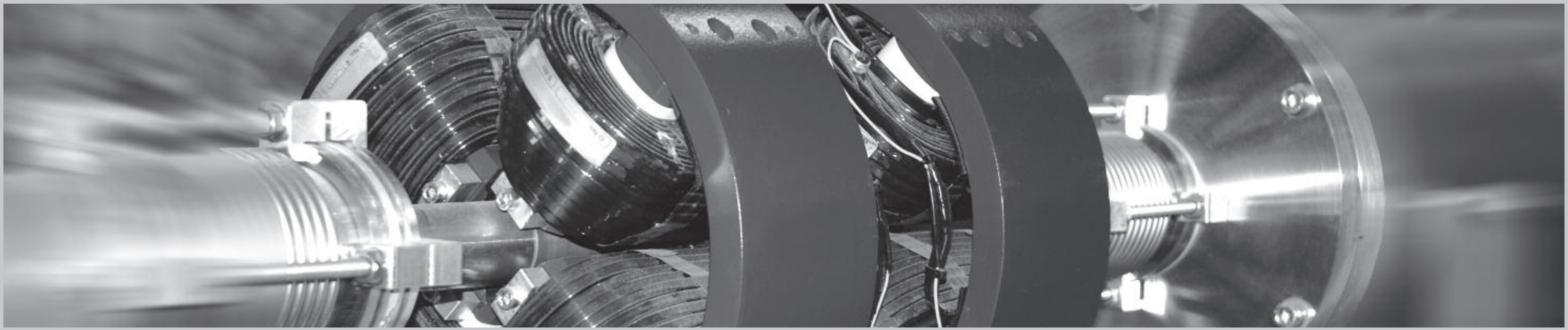

STU MTF

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