**Surface Characterization System**

completed by responsible coordinator of equipment

**Equipment: Surface Characterization System**

**No. of Equipment: UFCH32**

**Responsible coordinator:** Doc.RNDr., Ing. Martin Kalbáč, PhD.

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**Equipment Description**

**Combined ultra-high vacuum apparatus for complex study of thin films, interfaces and surface nanostructures (SPECSR) encompassing:**

**-** X-ray photoelectron spectroscopy (XPS) with microfocused (200 μm) monochromatic X-ray source (hʋ=1486.6 eV)  
- ultraviolet photoelectron spectroscopy with excitation of electrons by monochromatized He I (21.2 eV) and He II (40.8 eV) radiation   
- hemispherical electron energy analyzer with two-dimensional electron and ion detector and sample manipulator allowing measurement of high resolution spectra from room temperature down to liquid Helium temperature at different polar and azimutal detection angles, band structure mapping by angle-resolved photoemission spectroscopy (ARPES) technique using scanning angle lens   
- low-energy electron diffraction (LEED) technique for the determination of the surface structure and accurate surface atomic positions of materials   
- ion gun for cleaning of surfaces

- scanning probe microscopy (SPM) for investigations at atomic scale of a wide variety of materials

**Specification of expertise relevant to NanoEnviCz workpackages:**

|  |  |
| --- | --- |
| **WP3 SYNTHESIS AND DESIGN OF NEW MULTIFUNCTIONAL NANOMATERIALS FOR ENVIRONMENT PROTECTION** | |
| Conceptually new nanostructured materials with the potential for application in innovative technologies | x |
| Computer aided nanomaterials design | x |
| Low dimensional materials and their composites (carbon dots, nanotubes, graphene derivatives) | x |
| Nanofibers | x |
| Magnetic hybrids | x |
| Metal and metal oxide NPs | x |
| Redox active nanomaterials | x |
| Nanomaterials for biomedical applications | x |
|  | |
| **WP4 HETEROGENEOUS CATALYSIS FOR ENVIRONMENTAL PROTECTION** | |
| Nanomaterials for catalytic degradation of pollutants in water, soil and air |  |
| Nanostructured heterogeneous catalysts for abatement of pollutants from industrial processes and automotive transport |  |
| New “clean” catalytic processes for chemical production |  |
|  | |
| **WP5 NOVEL NANOMATERIALS AND TECHNOLOGIES FOR SUSTAINABLE PRODUCTION** | |
| Processes and technology for sustainable energy and chemical production |  |
| Catalytic processes for transformation of natural gas to liquids |  |
| Nanomaterials for utilization of renewables; Magnetically separable green catalysts |  |
|  | |
| **WP6 EFFECTIVE PHOTOCATALYTIC TECHNOLOGIES** | |
| Mastering nanomaterials for photocatalysis |  |
| Effective photocatalytic processes |  |
| Photovoltaic paints |  |
| Functional surfaces for environmental protection |  |
| Hybrid materials combining photocatalysts and heterogeneous catalysts |  |
| Thin photocatalytic films for direct solar splitting of water |  |
|  | |
| **WP7 NANOTECHNOLOGY FOR TRAPPING AND CHEMICAL DEGRADATION OF POLLUTANTS** | |
| Nanomaterials for sorption |  |
| Natural based nanomaterials produced by “green” technology |  |
| Reactive sorbents for degradation of pesticides and highly toxic agents |  |
| Degradation of chemical warfare agents |  |
| Analysis of filtering capabilities of nanomaterials |  |
| Elimination of radionuclides contamination |  |
| Modified nanofiber filters; Advanced antimicrobial filters/membranes |  |
| Nanoiron for groundwater and waste water treatment |  |
| Nano-trapping of heavy metals |  |
|  | |
| **WP8 SENSING AND MONITORING OF POLLUTANTS** | |
| Efficient sensing of pollutants |  |
| Biosensing by new devises |  |
| Application of new sensors in monitoring of pollutants |  |
| Magnetic sensors; Magnetically assisted SERS sensors |  |
| Advanced electrochemical sensors |  |
| Graphene based nanosensors |  |
|  | |
| **WP9 TOXICITY AND RISKS OF NANOMATERIALS** | |
| Health risks |  |
| Environmental risks |  |
| „In vitro“ and „in vivo“ toxicity tests – cytotoxicity, genotoxicity, interactions with membrane |  |
| RNA gene expression changes and protein expression changes |  |
| Complete eco/aquatoxicity ecotoxicity evaluation |  |
| Toxicity against bacteria and fungi |  |

**Detailed description of expertise**

**Please, specify the main research topics connected with equipment**:

Determination of electronic band structure, Fermi surfaces and the surface structure of thin films or two-dimensional materials. Identification of chemical bonding, depth profiling of the elements, surface morphology by high resolution microscopy.

**Please, specify the secondary research topics connected with equipment**:

Modification of samples by ion bombardment or plasma treatment. Deposition of thin metal films by e-beam evaporator.

**Keywords describing research area:**

ARPES, XPS, LEED, SPM, Surface chemical composition, Elemental compositions, Electronic structure

**Competence**

**Relevance for applied and industrial research:**

**Relevance for fundamental studies:**

The determination of surface chemical composition and electronic structure is crucial for understanding of unique physical and chemical properties of new materials.

**Comments**