**Nanoindentor (Pro-NanoEnviCz II)**

completed by responsible coordinator of equipment

**Equipment: Nanoindentor**

**No. of Equipment:** UFCH24

**Responsible coordinator:** Ing. J. Rathouský

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**Equipment Description**

The Hysitron TI 980 nanoindenter provides rapid, multi-sample and multi-technique automated testing capabilities for high-throughput characterization. It includes quantitative nanoscale-to-microscale indentation, nanoscratch, nanowear, high-resolution in-situ scanning probe microscopy (SPM) imaging, dynamic nanoindentation, and high-speed mechanical property mapping; providing a comprehensive understanding of material behavior at the nanoscale. The equipment enables:

1. quantitative determination of localized mechanical properties such as elastic modulus, hardness, creep, stress relaxation, and fracture toughness for a wide variety of materials,
2. continuous measurement of elastic-plastic and viscoelastic properties as a function of indentation depth, frequency, and time,
3. to obtain comprehensive nanomechanical property maps and property distribution statistics in a record amount of time.

**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 |  |
| Low dimensional materials and their composites (carbon dots, nanotubes, graphene derivatives) | x |
| Nanofibers |  |
| Magnetic hybrids |  |
| Metal and metal oxide NPs | x |
| Redox active nanomaterials |  |
| Nanomaterials for biomedical applications |  |
|  | |
| **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 | x |
| Effective photocatalytic processes | x |
| Photovoltaic paints | x |
| Functional surfaces for environmental protection | x |
| Hybrid materials combining photocatalysts and heterogeneous catalysts | x |
| Thin photocatalytic films for direct solar splitting of water | x |
|  | |
| **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**:

The rapid technological advancement is closely linked to the development of qualitatively novel materials, the mechanical properties of which are often unknown. The equipment enables to determine the mechanical properties of such materials at the nanoscale, which are crucial for their successful development and application.

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

In the coupling with the model accelerated weathering, the determination of the durability of thin coatings on a range of substrates

**Keywords describing research area:**

Nanoindentation, Thin coatings, Hardness, Loss modulus, Storage modulus, Nanoscratch, Nanowear

**Competence**

**Relevance for applied and industrial research:**

Most important fields of application include the development of thin nanostructured layers suitable for photocatalytic and photoelectrochemical technologies, the development and testing of the protective coatings for applications in the cultural heritage conservation and testing the durability of novel materials under demanding operating conditions.

**Relevance for fundamental studies:**

The detailed knowledge of the mechanical properties and durability of novel nanostructured materials is crucial for their successful development and determination of the structure-performance correlations.

**Comments**