**EQUIPMENT *(Chromium X)***

*(completed by the responsible coordinator of equipment)*

**Equipment: *equipment*** *e.g. Chromium X, 10x GENOMICS****, (Pro-NanoEnviCz III)***

**No. of Equipment: IEM 13**

**Responsible coordinator:** Mgr. Kateřina Hoňková, Ph.D.

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**Equipment Description**

Chromium X is an advanced versatile instrument used in various fields, such as genomics, epigenomics, immunology, or oncology, to perform single-cell analyses. The automatization of cell partitioning and barcoding allows for both low and high throughput experiments analyzing RNA, protein and chromatin at a single cell resolution.

Using Chromium X, the samples can be processed for:

1. Single Cell 3' Gene Expression
2. Single Cell Immune Profiling
3. Single Cell Assay for Transposase-Accessible Chromatin (ATAC)
4. Single Cell Multiome ATAC + Gene Expression

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

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| **WP3 SYNTHESIS AND DESIGN OF NEW MULTIFUNCTIONAL NANOMATERIALS FOR ENVIRONMENT PROTECTION** |
| Conceptually new nanostructured materials with the potential for application in innovative technologies |  |
| Computer aided nanomaterials design |  |
| Low dimensional materials and their composites (carbon dots, nanotubes, graphene derivatives) |  |
| Nanofibers |  |
| Magnetic hybrids |  |
| Metal and metal oxide NPs |  |
| Redox active nanomaterials |  |
| Nanomaterials for biomedical applications | X |
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| **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 |  |
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| **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 |  |
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| **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 |  |
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| **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 |  |
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| **WP8 SENSING AND MONITORING OF POLLUTANTS** |
| Efficient sensing of pollutants | X |
| Biosensing by new devises | X |
| Application of new sensors in monitoring of pollutants | X |
| Magnetic sensors; Magnetically assisted SERS sensors  | X |
| Advanced electrochemical sensors | X |
| Graphene based nanosensors | X |
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| **WP9 TOXICITY AND RISKS OF NANOMATERIALS** |
| Health risks  | X |
| Environmental risks | X |
| „In vitro“ and „in vivo“ toxicity tests – cytotoxicity, genotoxicity, interactions with membrane | X |
| RNA gene expression changes and protein expression changes | X |
| Complete eco/aquatoxicity ecotoxicity evaluation | X |
| Toxicity against bacteria and fungi | X |

**Detailed description of expertise**

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

Chromium X is a state-of the-art device for single-cell analyses that enables to study mechanisms of interactions between nanomaterials and biological system on a molecular level in individual cells. In comparison to bulk sample analyses (providing an average signal of all the tested cells), single-cell analyses enable the study of each cell's unique genetics, gene expression, and other molecular features. As such, single cell analyses detect heterogeneity within the tissue or cell populations and reveal mechanism of different cell functions and behaviors in response to various stimuli, such as nanomaterial treatment.

The main research topics are related to nanomedicine (drug development, personalized medicine), and nanosafety (nanotoxicity, adverse outcome pathways, new approach methodologies).

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

Chromium X can be employed in microbiology (interactions between nanomaterials and microorganisms, microbial resistance), environmental biotechnology (bioremediation, wastewater treatment), and other environmental sciences (biomonitoring, biosensoring).

**Keywords describing research area:**

Single cell analyses, single cell sequencing, nanotoxicology, nanomedicine, adverse outcome pathways, transcriptomics

**Competence**

**Relevance for applied and industrial research:**

Chromium X is widely applicable in life sciences research, pharmaceutical development, microbiology, as well as clinical diagnostics. In the environmental sciences, single cell analyses are applicable in microorganism-based remediation and monitoring. In summary, the main application areas are the *in vitro* assessment of nanotoxicity and nanosafety and high-throughput screening of biological effects of nanomaterials.

**Relevance for fundamental studies:**

Single cells analyses are applicable in all areas of fundamental research requiring understanding of molecular mechanisms of interactions between cells and nanomaterials. By providing detailed molecular insights, researchers can achieve a new level of precision in understanding and manipulating biological systems at the single-cell level.

**Comments**