**Equipment:** Microarray laser scanner

**No. of Equipment: UJEP 27**

**Responsible coordinator:**  Mgr. Jan Malý, Ph.D.

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**Equipment Description**

**Description of equipment:**

Specifications and technical features:

Instrument dedicated for development of novel sensitive optical protein/DNA/whole cell microarray diagnostic devices (biosensors) for environmental or biomedical applications. It enable to perform a highly sensitive scanning of fluorescence signals located on micrometer-sized spots of fluorescently labeled molecules attached to active biosensor surface. Instrument is equipped with powerful software for fast analysis of acquired data from individual spots with 3 µm scan resolution. It represents automated solution to innovative microarray research, genomics, proteomics and diagnostics, and is essential equipment for life science and healthcare related basic and application research.

Key technical parameters:

Lasers - Thermoelectrically cooled laser diodes with stabilized feedback output

Excitation wavelengths - 532 and 635 nm

Laser power - adjustable

Gain PMT - Linear from 0 to 100%

Autofocus - Real-time and automated

Detection - confocal and high performances digital laser/PMT system

Optical resolution - 3 µm

Pixel size - 3 µm to 40 µm

Scanning time - 3.5 min per 22 x 74 mm substrate at 10 µm resolution

Full substrate slide area (22 x 74 mm)

Sensitivity - 0.05 fluor/µm²

Dynamic range >10,000-fold

Open platform glass substrate slides (25 x 76 mm)

Highly accurate grid positioning using automatic spot recognition for accurate quantification and 16-bit exportable TIFF data

Compatible fluorophores: Cy5.5 (685 nm); Cy5, Alexa 647, Alexa 660 (635 nm); Cy3, Alexa 546, Alexa 555 (532 nm)

**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 |  |
| 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 |
|  | |
| **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 | x |
| 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 | x |
| Environmental risks | x |
| „In vitro“ and „in vivo“ toxicity tests – cytotoxicity, genotoxicity, interactions with membrane |  |
| RNA gene expression changes and protein expression changes | x |
| Complete eco/aquatoxicity ecotoxicity evaluation |  |
| Toxicity against bacteria and fungi |  |

**Detailed description of expertise**

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

**Health and environmental risks**

Protein and whole-cell biosensors

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

Nanomaterials for biomedical applications – development of novel signal amplification strategies

**Keywords describing research area:**

Microarrays, biosensors, proteins, nucleic acid, fluorescence, nanoparticles

**Competence**

**Relevance for applied and industrial research:**

Development of novel diagnostic approaches for environmental and biomedical applications

**Relevance for fundamental studies:**

Novel protein and whole-cell biosensors for environmental and biomedical applications

Nanomaterials for biomedical applications – development of novel signal amplification strategies

**Comments**

Instrument will be used as a platform for development of novel sensitive optical protein/DNA/cell microarray diagnostic devices (biosensors) for environmental or biomedical applications. It will enable to perform a highly sensitive scanning of fluorescence signals located on micrometer-sized spots of fluorescently labeled molecules attached to active biosensor surface. Instrument will be equipped with powerful software for fast analysis of acquired data from individual spots. Furthermore, due to possibility to scan a microspots on standard glass microscopy slides, biosensors can be produced combining a traditional bioanalytical approaches and miniaturization achieved by microarraying of detection molecules and integration of microfluidics. Purchase of microarray laser scanner will therefore speed up the development of novel optical biosensor devices at UJEP and will complete an instrumental portfolio dedicated to research in environmental and biomedical diagnostics. It will also open further possibilities for application oriented research and contracted research which will be opened for partners of infrastructure consortium.