Research projects

Programme P2-0213 Textiles and Ecology+

Research under the programme includes the development of technologically innovative production processes for advanced fibrous and other polymer materials while considering the principles of sustainable development. An important goal of the research is to create multifunctional special textiles with applications in medical, hygienic and protective textiles with antimicrobial activity, flame retardancy, water- and oil-repellency, self-cleaning, electrical conductivity, the ability to release active substances, UV protection, electromagnetic shielding and other functionalisations. Another goal is to create novel temperature-, pH- and light-responsive smart textiles. Towards this end, we develop environmentally friendly processes involving spinning, drawing, weaving, enzyme and plasma treatment, the in situ synthesis of nanoparticles, dyeing, printing, sol-gel technology and microencapsulation. In the field of smart materials, printed electronics is introduced for the purpose of wearable electronics. For the integration of conventional electronic components, different contact procedures are used. In the field of technical textiles and green composites, the production of flax and coarse wool of Slovenian origin is revived. The use of eco-design in the design of new products is investigated at all stages of production and end use. Furthermore, textile waste and options for recycling are studied. In this research, the most advanced analytical methods, image processing procedures and statistical methods will be used.
The research agendas of the programme are modern, technologically innovative and based on interdisciplinary knowledge and integration. They combine fibrous and other polymeric materials as well as textile, graphic, chemical and electrotechnical technologies. In the research, a sustainable approach will be of primary importance. An important goal of the programme is the transfer of laboratory results to new industrial processes.
Research under the programme contributes significantly to the technological development of the Slovenian textile and graphics industry and increases its competitiveness, facilitates the development of under- and postgraduate education in the field of textiles and graphics and enhances the education level of employees in the economy, preserving Slovenian professional terminology, promoting Slovenian science and enhancing awareness of sustainable development.

EU project CLEANTEX: CLEAN AND INNOVATIVE TEXTILES STRATEGY FOR CIRCULAR ECONOMY+

The consortium: Kaunas University of Technology, Lithuania, as project coordinator; University of Ljubljana, Slovenia; AEI Tèxtils and LEITAT, Spain; CRE.THI.DEV, Greece; CIAPE and Environment Park, Italy; and Ecole Nationale Superieure d'Arts Industries Textiles, France.

CLEANTEX aims to promote the uptake of circular economy and eco-design concepts to improve the skills of students in textile engineering and workers in the sector through cross-sectoral cooperation in HEIs in order to tackle the main pollution problem in textile industry and reach a more sustainable sector. Moreover, CLEANTEX is aligned with the renewed Circular Economy Action Plan and the new Industrial Policy released on March 2020. In addition, CLEANTEX will also leverage the new European Commission textile policy by 2021.

CLEANTEX is co-financed by the ERASMUS+ program of the European Commission under the call for Strategic

Partnerships for higher education, with the Grant Agreement number 2020-1-LT01-A203 -077874. The project started on November 1st 2020, it has a duration of 27 months.

CELSA: SMARt biomaterials for bioprinting of vascularized TISsues (SMARTIS))+

CELSA: SMARt biomaterials for bioprinting of vascularized TISsues (SMARTIS))

Partners: dr. Heidi Declerq (Department of Development and Regeneration, KU Leuven, Belgija – koordinatorica projekta), dr. Andrzej Kotarba (Department of Inorganic Chemistry, Faculty of Chemistry, Jagiellonian University, Poljska) in dr. Brigita Tomšič (Oddelek za tekstilstvo, grafiko in oblikovanje, Naravoslovnotehniška fakulteta, UL, Slovenija).

Duration: 2020–2022

The biofabrication of 3D biomimetic tissue analogs that precisely mimic the properties of native tissue samples have enormous potential in biomedical applications (drug discovery, cancer research, regenerative medicine,…). A basic requirement for the survival, maturation and function of 3D-engineered tissues is the establishment of blood vessels. The most critical challenge in complex tissue engineering is the integration of a hierarchical vascular network. This project integrates biomimetic approaches with bioprinting by combining knowledge of self-assembling vascularized spheroids with smart biomaterials to generate vascularized tissues. Smart biomaterials include nanoparticles, microgels and stimuli-responsive biomaterials or combinations thereof, all of which have a cell-instructive effect at either the single cell level, heterocellular spheroids or 3D tissue analogs.

European Project APPLAUSE UIA+

European Project APPLAUSE UIA (main coordinator: City of Ljubljana, coordinator at NTF: assist. prof. dr. Marija Gorjanc) (2017-2020)

The project addresses unresolved issues regarding the management of invasive alien plant species (IAPS) in terms of a zero-waste approach and a circular economy. As part of the project, the application solutions for the use of IAPS for the production of sustainable textile and paper products were studied at the Faculty of Natural Sciences and Engineering, University of Ljubljana. Our research is focused on obtaining dyes from IAPS by water extraction process, textile dyeing, paper printing, design and production of eco-packaging.

Biodegradation of cotton fabrics impregnated with Cu-based nanoparticles in soil and compost+

Biodegradation of cotton fabrics impregnated with Cu-based nanoparticles in soil and compost (bilateral project with the Faculty of Technology and Metallurgy University of Belgrad, project leader: assist. Prof. Brigita Tomšič; duration: 2020-2022)

The biodegradability of textile fibers is extremely important in the management of textile waste, as it is one of the indicators of the environmental friendliness of the material. In addition to the origin of textile fibers, the presence of various finishing agents used in the finishing processes of textile production has a great influence on their biodegradability. These can negatively affect the biodegradability process of those fibers that are otherwise naturally readily biodegradable.

The aim of this project is to investigate the presence of copper nanoparticles (Cu NP) on the biodegradation of cotton fibers in order to answer the following questions: (i) to what extent Cu NP affects the biodegradation of functionalized cotton fabric, (ii) whether the concentration of Cu NP affects the biodegradation of the studied samples, (iii) how the presence of different matrices or. the cross-linking agents on the fibers affects the biodegradation process of the nanocomposite samples; and (iv) to what extent the microbial activity in the test soil changes during the biodegradation process of the studied nanocomposite samples.

Ecologically friendly in-situ synthesis of ZnO nanoparticles for the development of protective textiles+

Ecologically friendly in-situ synthesis of ZnO nanoparticles for the development of protective textiles (basic research project co-financed by Slovenian Research Agency; project leader: assist. prof. dr. Marija Gorjanc) (2019-22)

Two new, environmentally friendly processes of in-situ synthesis of ZnO nanoparticles directly on a textile substrate will be developed. In the wet chemical process, the nanoparticles on the fibres will be formed using a reducing agent extracted from the plants, while the nanoparticles in the dry chemical process will be formed in a low-pressure plasma system, using thermodynamically nonequilibrium gas. Both processes of in-situ synthesis of ZnO nanoparticles represent a completely new approach to textile modification for the development of multi-protective and multi-functional textiles and provide possibilities for the synthesis of other nanoparticles and nano-structures on textiles. Both approaches are crucial in successfully overcoming technological and ecological issues in the field of textile and fibrous polymers modification processes.

Monitoring of plasma treatment efficiency for textile surface modification+

Monitoring of plasma treatment efficiency for textile surface modification (bilateral project with Institute of Physics Belgrade; project leader: assist. prof. dr. Marija Gorjanc) (2018-2019)

Textiles of different fibre composition (cotton, polyester and their mixture) and construction parameters were modified with plasma under different conditions (gas, pressure, reactor power). Surface changes during plasma treatment were monitored by optical emission spectroscopy, with the aim of monitoring the modification and determining the end point of the treatment. As the ecological aspect of textile processing is extremely important for the design of high value-added products, textiles were also analysed for their biodegradation and dyeability with invasive plant extracts.

Development of biodegradable and antimicrobial cellulose composites from waste material+

Development of biodegradable and antimicrobial cellulose composites from waste material (bilateral project with Faculty of Textile Technology Zagreb; project leader: assist. prof. dr. Marija Gorjanc) (2020-2022)

The environmental protection has become extremely important, which also leads to a greater need for better waste management. The research of the project is focused on the use of waste material for the development of a new cellulose composite, which will be ecologically acceptable according to the principle of “Life Cycle Assessment”. The new composite material will be biodegradable and also antimicrobial, and could be used for a production of personal hygiene products.

Research of the possibility of using keratin from domestic sheep wool for obtaining nanofibers and making

filters from them (bilateral project BI-BA19-20-041)+

Research of the possibility of using keratin from domestic sheep wool for obtaining nanofibers and making filters from them (Bilateral project with University of Banja Luka, Faculty of Technology, leader: Assoc Prof dr. Tatjana Rijavec)

Wool is potential absorbent for removing of toxic substances from contaminated water and is suitable for the production of wool fibre's filters. The aim of the project is to develop bioabsorbents based on wool keratin. The electrospinning process is used to develop nanofibrous materials from extracted keratin and biodegradable polymer. A sorption of heavy metal cations and waste pharmaceuticals is studied in the laboratory.

Multifunctional woven composites for thermal protective clothing (MF-WCOMPROTECT)+

Multifunctional woven composites for thermal protective clothing (MF-WCOMPROTECT) is a Croation national project – researcher in the project Assoc Prof dr. Tatjana Rijavec)

The development of composite fabrics for outerwear is based on a new fabric construction that will provide good mechanical properties, fire resistance and thermal insulation as required for this type of protective clothing. The goal is to make a lightweight compact fabric by tying the top and bottom fabric of different functional properties.

MPNS COST Action MP1105+

Sustainable flame retardancy for textiles and related materials based on nanoparticles substituting conventional chemicals (FLARETEX)
The scientific context of the COST Action MP1105 is concerned with the replacement of existing flame retardants with sustainable and environmentally friendly alternatives for textiles in domestic, safety, transport (automotive, rail, aerospace and marine), civil emergency and military, construction and other industries. The aim of the action is to form a European multidisciplinary Knowledge Network on Sustainable Flame Retardancy to facilitate the rapid development of new innovative halogen-free flame retardants with low fire toxicity and environmental impacts using all the available technologies.

Investigation of the possibility of using short flax fibres...+

Investigation of the possibility of using short flax fibres for the production of filters for removal of heavy metals ions from aqueous solutions (bilateral project with University of Banja Luka, Faculty of Technology, leader: assist. prof. dr. Marija Gorjanc)

Water and soil pollution by heavy metals is a major problem, as it represents an immediate danger to human health. The presence of heavy metals in water, even at low concentrations, can cause serious health problems. The existing methods for heavy metal removal from water have some disadvantages such as high cost of sorbents and their low biodegradation after sorption. For this reason, the aim of the research is to find sorbents based on natural, waste and biodegradable materials that would provide solutions in the field of heavy metals removal from water. Due to their chemical and physicalmechanical properties, lignocellulose materials such as flax can be used as a sorbent.

Modification of textiles...+

Modification of textiles by plasma and nanoparticles for development of protective and healthcare textiles (bilateral project with University of Zagreb, Faculty of Textile Technology, leader: assist. prof. dr. Marija Gorjanc)

An important part of the textile industry is the development of antimicrobial textiles for medical, healthcare and hygienic purposes. The increasing environmental concerns and demand for environmentally friendly processing of textiles has led to the development of new technologies, the use of plasma being one of the suitable methods. The aim of the research of the project is modification of textiles using plasma for increasing adhesion capacity towards nanoparticles and to achieve antimicrobial properties of treated textiles.

Tailoring innovative functional textiles...+

Tailoring innovative functional textiles using plasma and microcapsules (bilateral project with the Institute of Physics in Belgrade, leader: assist. prof. dr. Marija Gorjanc)

The emphasis of the proposed project is modification of textile properties, with a focus on creating innovative functional and smart textile products. Microencapsulation technology imparts finishing procedures in textiles in a way that is not possible or feasible with other technologies. Since there is no affinity between the microcapsules and the substrate, it is necessary to use binders that are in some cases hazardous to humans and animals. Additionally, the problem with microcapsulefunctionalised textiles is the durability of their properties with repeated use. Textiles will be modified by using gaseous plasma and additionally treated with microcapsules of different effects.