NATO OTAN

Science for Peace and Security (SPS) Programme

SPS MULTI-YEAR PROJECT

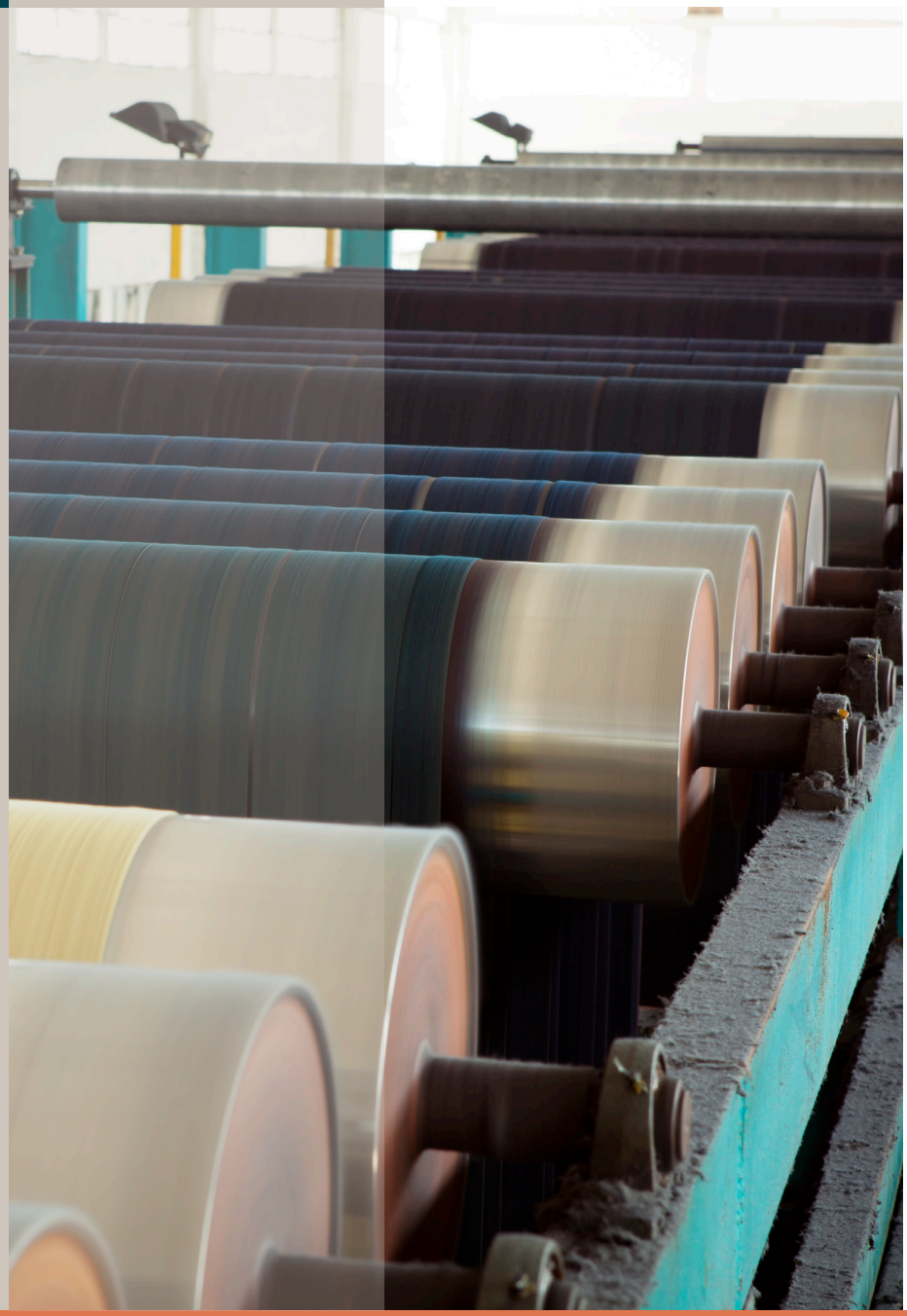
Nanocoatings for multi-protective textiles used for military clothing MULProTex

Emerging Security Challenges Division

Project Overview

The MULProTex project aims to develop multi-protective military clothing for fire, micro-organisms organophosphorus-containing nerve agents, and UV-light protection through the application of non-toxic and renewable multilayer nanocoatings and indicating dyes using layer-by-layer assembly deposition. The multi-functionality of military clothing has always been a major research topic amongst military, academic and industrial textile specialists. Most clothing today combines one or two properties achieved by traditional non-energy efficient finishing processes that produce uncomfortable textiles containing chemicals that are toxic for humans. The consequent need to find low cost, non-toxic and simply applicable textile treatment that can provide multifunctional properties is heightened due to increasingly rigorous environmental protection rules.

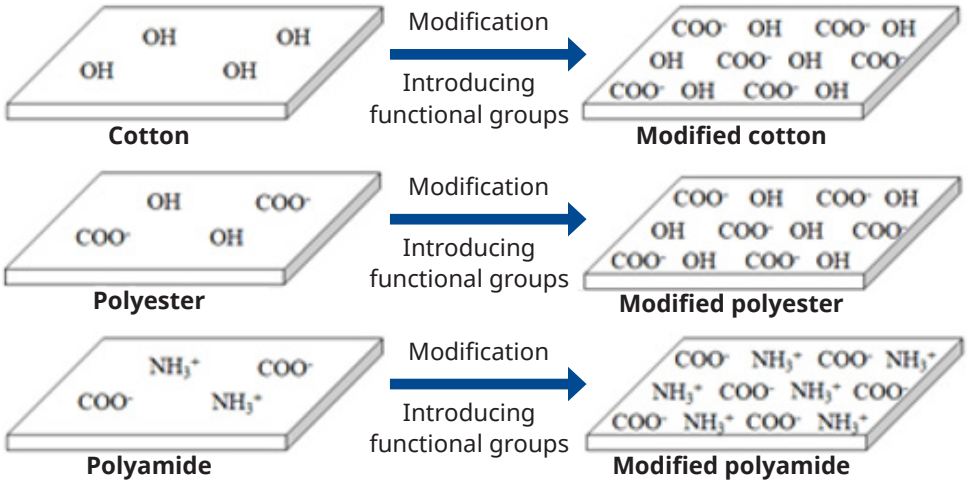
This project will use water-based multilayer nanocoatings composed of non-toxic, eco-friendly, and renewable polyelectrolytes together with low molecular weight additives, nanoparticles, and nerve agent indicating dyes. This layer-by-layer assembly is a simple, inexpensive, environmentally-benign and highly tailorable water-based technique, performed by alternate exposure of a substrate to oppositely-charged polyelectrolyte solutions or suspensions at room temperature, giving rise to a multilayer thin nano-film. It is one of the most promising techniques for textile finishing that could be easily employed using traditional pad-dry processing widely used in the industry. It also allows the design of an unlimited combination of assemblies with impressive multi-functionality. Thin nanocoatings created with this technique are promising for applications requiring comfort and the desired mechanical properties of the textile substrates.



Deliverables

- Definition and test of the most used textile fabrics for military clothing, in terms of their fibre composition and fabric construction;
- Exploration of proper treatment with enzymes, oxidants, atmospheric corona discharge (or their combinations) for optimal surface modification and functionalization of textile fabrics, making them more amenable for nanocoating deposition, while avoiding fibre degradation;
- Definition and development of multi-protective textile fabrics for fire, antimicrobial, UV-light and nerve agents protection using multilayer nanocoatings composed of polyelectrolytes, low-molecular weight additives, nanoparticles, and nerve agent indicating dyes;
- Production and test of a prototype of multi-protective military clothing based on the project results.

Surface modification and functionalization



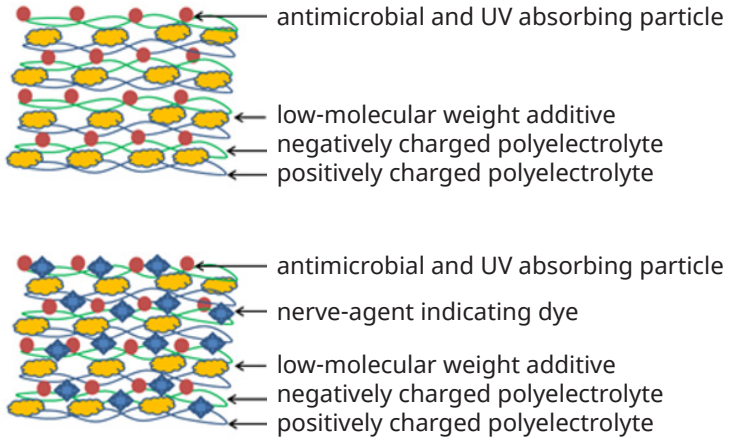
Outcome

MULProTex will enhance the protection of personnel and soldiers against nerve agents, microorganisms, fire and radiation. Through this project, the Faculty of Technology and Metallurgy in Skopje will benefit from the establishment of a laboratory for advanced materials.

This project will contribute to the protection of the environment through the implementation of a circular economic concept that stimulates the use of renewable chemicals. Creating multi-protective textile materials by implementing a circular economy concept using non-toxic and renewable polyelectrolytes from waste is a new "green" concept in textile finishing that will change the face of military clothing production.

Furthermore, MULProTex will advance multi-protective nanocoating technologie that are understudied despite being a matter of great scientific concern. Developing such products will widen and scale-up possible applications, and open up new perspectives for using the layer-by-layer deposition technique to produce nanocoatings suitable for other applications.

Multilayer nanocoating



Participating Institutions

Texas A&M University, College of Engineering

TEXAS A&M UNIVERSITY Engineering

Texas A&M University, founded in 1876, is a public, comprehensive university. It is one of the few institutions holding triple federal designations as a land-, sea- and space-grant university in the United States.

The University's College of Engineering is one of the largest engineering schools in the country. Its researchers have established pre-eminence in the research areas of autonomy and robotics; energy systems and services; education and training; health care; information systems and sensors; materials and manufacturing; national security and safety; and infrastructure. Underlying technologies that propelled the college to the forefront of the above research areas include mathematical modelling and simulation, optimization, mechanics, sensors, structures, robotics, autonomous vehicles, communications and networks, process engineering, materials, and computational sciences.

University of Belgrade, Faculty of Technology and Metallurgy

Универзитет у Београду
Технолошко-металуршки факултет

The Textile Engineering Department of the University of Belgrade has a long tradition of offering prominent multiplicity of scientific, technical and specific educational activities. Its studies on textile fibers include the analysis of fiber structure and structure-properties relationship. Modification of the fiber structure and surface for the application in composite materials, ion exchange systems and biologically active materials are also examined.

Recent research is mainly focused on the application of advanced methods for modification of textile materials based on natural and synthetic fibers in order to enhance their functionality. RF low-temperature plasma and corona treatments, enzymatic and biopolymer chitosan treatments are used as potentially environmentally friendly methods for imparting specific functional properties to textile materials necessary for design and production of high added value textile products.

Ss. Cyril and Methodius University in Skopje, Faculty of Technology and Metallurgy

The Faculty of Technology and Metallurgy in Skopje is a leading and eminent higher education institution in North Macedonia. Founded in 1959, the Faculty has remarkably contributed to the development of the Macedonian economy, primarily through the education of highly qualified engineers and staff, following all modern market trends and scientific developments.

Within the Faculty, the Textile Department, with its 50 years tradition in education, research and industrial collaboration, is one of the most prominent and recognized educational institution among the textile industry in North Macedonia. The textile department is divided into textile chemistry, mechanical textile technology and garment production.

Today, the main mission of the Faculty is to ensure the continuous development of its appropriate human resources by offering recognized and high-quality studies and research programs. It will allow the faculty to keep its high reputation in the field, and to maintain and build relationships with similar scientific institutions and companies worldwide.

The Science for Peace and Security (SPS) Programme

The Science for Peace and Security (SPS) Programme is an established brand for NATO based on four pillars: science, partnership, security, and unconventional issues (hybrid threats). It has been contributing to the core goals of the Alliance for more than six decades. Today, the SPS Programme continues to be one of the largest and most important partnership programmes addressing 21st century security challenges, particularly cyber defence, counter-terrorism, CBRN defence, energy security and advanced technologies.

The NATO Science for Peace and Security (SPS) Programme enhances security-related civil science and technology to address emerging security challenges and their impacts on international security. It connects scientists, experts and officials from NATO and Partner countries to work together to address these challenges. The SPS Programme provides funding and expert advice for security-relevant activities in the form of Multi-Year Projects (MYP), Advanced Research Workshops (ARW), Advanced Training Courses (ATC), and Advanced Study Institutes (ASI). SPS activities are always demand-driven, modular, and designed to meet the requirements of the nation(s) and end user(s). The relevance of SPS activities in response to NATO Strategic Objectives and political priorities is reinforced also via special calls, which are issued on an ad hoc basis to draw the attention of the scientific community towards current topics of interest for Allies.

Every year, approximatively 2000 experts participate in SPS activities and help to build capacity in partner nations, and support NATO's goals.

More than 20 Nobel Laureates have been involved in the SPS Programme, a testament to the scientific excellence supported by the SPS Programme.

Young scientists are also actively supported through SPS activities, which contribute to broaden their professional network and scientific expertise.

The SPS Programme also has a high public diplomacy value for NATO, providing the Alliance with separate, non-military communication channels by bringing together experts from NATO and Partner countries, often in situations or regions where other forms of dialogue more directly focused on defence and security are difficult to establish. Accordingly, the Programme enables NATO to become actively involved in such regions, often serving as the first concrete link between NATO and a new Partner.

Emerging Security Challenges Division

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