„Biodegradable non-woven fabrics with 3D network multiwall carbon nanotubes, possibilities of multifunctional modifications”

Fabrics can be modified by deposition on their surfaces, by dip coating or padding in a suspension, multi-walled carbon nanotubes (MWCNTs), which form a spatial electrically conductive network. Such materials are a new class that belongs to the so-called smart textiles, that combines the advantages of fabrics, such as lightness, softness, porosity and large surface area with good electrical conductivity, which creates the possibility of further modification, for example by electrochemical deposition of nanoparticles, and perspectives of numerous applications, for instance as electrodes in batteries, catalyst supports, thermoelectric materials, antistatic materials, materials shielding electromagnetic radiation.

The project „Biodegradable nonwovens with spatial network of multiwall carbon nanotubes, possibilities of multifunctional modification” focuses on obtaining of such conductive hybrid materials, based on nonwovens of polylacide (PLA), polymer which is biodegradable, compostable, and biobased - produced from agriculture products. Studies of the formation of conductive networks on nonwovens with fibers of different diameters, obtained by electrospinning, and with surface roughness modified by physical or chemical methods, will enable understanding of the mechanism of the MWCNTs network formation. It is important to use MWCNTs harmless for human health. The structure and properties of the nonwovens will be investigated and also electrical conductivity, as well as the influence of mechanical deformation and ambient temperature on the conductivity. The possibilities of further functionalization of these systems will be explored, such as electrochemical deposition of metal nanoparticles exhibiting antibacterial activity, and modification with silanes in order to impart super-hydrophobicity. In the latter case, the nanostructure formed on the surfaces of fibers plays a fundamental role. The antibacterial activity as well as hydrophobicity of the modified nonwovens will be examined. Many techniques will be used in studies, like atomic force microscopy, electron microscopy, calorimetry, X-ray methods, infrared spectroscopy, nuclear magnetic resonance, electrical conductivity measurements.

Results of the project will enable to achieve understanding of the mechanism of the formation of conductive MWCNTs network on the surfaces of textiles and will contribute to broadening of the knowledge of nanocomposites based on biodegradable polymers produced from agricultural products. We expect the results will contribute in the future to creation of the basis for the production of a new class of materials - multi-functional nonwovens on an industrial scale.