SHORT TERM SCIENTIFIC MISSION (STSM)
SCIENTIFIC REPORT

This report is submitted for approval by the STSM applicant to the STSM coordinator

Action number: CA17107
STSM title: Electrospinning and characterization of polyurethane composite smart textile for medical application
STSM start and end date: 10/05/2021 to 28/05/2021
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The main purpose of the short-term research mission was to obtain electrospun polymer/polyurethane hydrogel composites for medical use. First the process of electrospinning was optimized in order to obtain fibrous electrospun polymer/polyurethane hydrogel, and then the cytotoxicity of both the gels themselves and the obtained samples was examined. These hydrogels have the ability to behave in the same way as soft tissues, but their application can be improved and expanded by obtaining another method - electrospinning. Electrospinning is a well-known method for obtaining materials for medical use. In this way, it is possible to obtain a polyurethane composite material that will be a carrier of the drug substance, or cells, while it will be closed within a polymer matrix so that it will become active only after application. The polymer matrix used was polylactide, which is biodegradable and biocompatible polymer. As the question is no longer whether research data should be exchanged, but how to make it more efficient, the purpose of the short-term scientific mission was to strengthen communication and exchange results between institutions. The purpose of this short-term scientific mission was to make a significant contribution to the goals of COST Action CONTEXT.

DESCRIPTION OF WORK CARRIED OUT DURING THE STSMS

During the STSM 12 samples of polyurethane hydrogels (PU-hydrogels) were synthesized. Samples were obtained using 4 different components of polyethylene glycol-like polyol (PEG) (Mw 2000, Mw 4000, Mw 6000 and Mw 10000) in a tetrahydrofuran-like solvent. The samples were washed from isocyanate, by water and then dried, this washing was done 3 times, after which they were dried. Such samples were crushed to a size not exceeding 0.6 mm, sifted through a 0.6 mm sieve. These samples were placed on an indirect cytotoxicity test method. The samples were placed for analysis in the active medium in which they swelled for 24 h, after which they were filtered and the cells were seeded in the liquid. The samples were incubated for 48 h, and then the number of surviving cells was counted under a microscope. During the same week, the effect of the 4 different solvent systems, found in literature, on the electrospinning process of 3 polymers was investigated, The best results were obtained with a solution of polylactic acid (PLA) in a pure chloroform, which enabled a continuous electrospinning process and obtainment of a fibrous structure with a mean fiber diameter of 2 µm . In the second week, electrospinning of PU-hydrogels and PLA was performed in one needle, where the dry hydrogel was added to the polymer solution immediately before spinning. The samples were observed under microscope to confirm their fibrous structure and the Raman and Infrared spectroscopy were used to evaluate the presence of the PU-hydrogels in the electrospun samples. During the last week, the cytotoxicity of the obtained electrospun PLA/ PU-hydrogels was examined in another way, by the direct method, so that parts of the sample, after sterilization, were immersed in the serum in which the dispersed cells were located. The number of live cells was counted after 48 h.

DESCRIPTION OF THE MAIN RESULTS OBTAINED

The morphological characterisation of the electrospun PLA/PU hydrogel samples confirmed a successfull obtainment of fibrous structure with a mean fibre diameter of 2 μm for all samples.
The results of the Raman spectroscopy analysis confirmed the presence of the hydrogels in the electrospun samples. These findings were consistent with the results of the Infrared spectroscopy which also confirmed the presence of the hydrogels.
The indirect cytotoxicity test method applied on the hydrogels showed cell toxicity.
Also the direct cytotoxicity test method applied on the PLA/PU-hydrogel electrospun samples resulted with cells termination.
These results are a good basis for further research work. The succsessful obtainment of porous fibrous PLA mesh with incorporated PU-hydrogels provides the opportunity for their further upgrading as drug or cells carriers.
The negative outcomes of the cytotoxicity tests mean that a further purification of the PU-hydrogel after their synthesis is essential.

FUTURE COLLABORATIONS (if applicable)

After three weeks of STSM and preparation and testing samples at Research Center for Environment and Materials, Macedonian Academy of Sciences and Arts, North Macedonia, in addition to testing the samples, further joint work on the same samples is planned. The experience and input in working on this topic from the dr Aleksandra`s Laboratory of is invaluable as for my Phd thesis so for further scient work at my home institution. The contribution from the application and characterization of the samples has greatly contributed to the new ideas for the testing of hydrogels ana composite of electrospinned polymer and hydrogels and the possibilities of their application. Additional collaboration is planned on the characterization of samples already made and co-authored works planned over the coming months. Since the specimens examined are part of my doctoral thesis, the plan is to expand collaboration and continue on current samples and projects, and then extend the collaboration to other areas of work. It is hoped that this will establish good cooperation and the backbone for writing some joint projects in the near future.