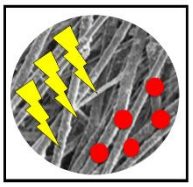

PiezoMat: Bio-inspired Smart Scaffolds for Real-Time Monitoring of Biological Processes of Neural Tissue Regeneration.

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DESCRIPTION FOR THE GENERAL PUBLIC

In contemporary times, nanotechnology is gaining increasing significance due to the development of Smart materials for tissue engineering. The current state of the art in neural tissue engineering is focused on minimally invasive and "intelligent" technologies. The goal is to design smart materials that can avoid complex and lengthy surgeries, which often result in complications and extended recovery periods. These materials are designed to respond to external stimuli (physical, chemical, mechanical) and behave similarly to the body's natural tissues. Piezoelectric materials fall into this category.

Piezoelectric materials are significant engineering materials characterized by their unique electrical properties, which arise from various polymorphic forms. Piezoelectric forms are technically most important due to their high piezoelectric, ferroelectric, and pyroelectric properties.

The aim of the PiezoMat project is to design innovative, multi-layered smart piezoelectric scaffolds capable of real-time tracking and analyzing biological processes, mimicking the natural mechanisms of monitoring and regulating nerve cells. The introduced nanoadditives will enhance the piezoelectric effect and enable observation of the regeneration of damaged nerves.

Electrospinning parameters such as temperature, solvent, feed rate, applied voltage, needle-to-collector distance, and collector rotation speed will be thoroughly investigated concerning the architecture of piezoelectric materials. This is crucial due to the complexity of nerve regeneration research, which requires more reliable information on the relationship between nerve cell behavior and the materials forming them. Additionally, the morphology of nerve cells and biocompatibility in the optimized scaffold with high polar phase content will be assessed.

One of the topics not widely described in the literature is the use of piezoelectric materials for cell cultures, which are stimulated by ultrasound waves of specific frequency and power. The application of ultrasound waves will allow the examination of the piezoelectric effect on nerve cell viability.

The results obtained from this project will enable the development of a method for producing multi-layer composite materials using electrospinning and alloy electrospinning, a deep understanding of the process, and defining the mechanisms influencing the formation of polar phases. Determining the influence of process parameters on piezoelectricity will define the most optimal process conditions for applications in neural tissue engineering**. The project will investigate the mechanisms occurring during the process, and the tangible outcome will be the development of technological assumptions for material production.**