

# Doctoral School of Information and Biomedical Technologies

## Polish Academy of Sciences (TIB PAN)

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**SUBJECT:** Injectable hydrogel-based nanofibrous scaffolds for tissue engineering

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**DESCRIPTION:** Injectable biomaterials are revolutionizing medical treatments by making them less invasive and more efficient<sup>[1]</sup>. These advancements are particularly crucial for treating soft tissues, such as the intervertebral disc (IVD), which plays a vital role in spine function and flexibility by absorbing stress and shock. Lower back pain, often caused by IVD degeneration and the nucleus pulposus (NP) with its 'jelly-like' extracellular matrix (ECM) is central to this issue.

Material scientists are at the forefront of developing nanomaterials for biomedical applications, focusing on minimally invasive approaches<sup>[2]</sup>. Our research aims to create advanced injectable biomaterials like hydrogels and nanoparticles to support cell viability, proliferation, and tissue regeneration for various applications, including cartilage and IVD. Injectable biomaterials not only offer a less invasive method of delivering drugs or cells but also provide unique features such as tissue mimicry, appropriate scaffolding for cells, and prolonged molecule delivery. These advancements are paving the way for the next generation of biomaterials in regenerative medicine.

The proposed PhD project is focused on designing and developing materials made by biopolymers via electrospinning and laser structuration. The obtained hydrogel-based nanostructures will be extensively studied to prove their superior features and exceptional functionalities. Finally, the applicability of nanomaterials in different fields of biomedical applications, including drug delivery and tissue engineering will be proved. Many articles published in international scientific journals with high impact factors and a few presentations at international conferences are expected to be obtained as the outcomes of this Ph.D. study path.

### REQUIREMENTS:

- Holding an MSc degree in Chemistry, Polymer Science, Physics, Nanotechnology, or any related field of Materials Engineering
- Solid background in polymer material development (expertise in electrospinning as well as hydrogel and conductive polymer nanomaterial fabrication is desirable)
- Keen interest in polymer nanomaterial characterization (e.g., SEM, AFM, FT-IR, XRD, DSC, TGA, Photothermal characterization, etc.)
- Ability to design, execute, and evaluate research experiments
- Excellent collaboration skills as well as the ability to work independently

- Highly capable of communicating scientific results in English, both orally and in writing

## **BIBLIOGRAPHY:**

- [1] Nakielski P. et al., Minimally invasive intradiscal delivery of BM-MSCs via fibrous micro scaffold carriers, *ACS Applied Materials and Interfaces*, pp.1-16, 2023
- [2] Nakielski P. et al., Laser-assisted fabrication of injectable nanofibrous cell carriers, *Small*, 18(2) pp.2104971-1-18, 2022