2025 International Conference on Biofabrication

niedziela, 14 września 2025 - środa, 17 września 2025

Palace of Culture and Science

Program

[221] 3D PRINTED BIO-BASED SCAFFOLD FOR CARTILAGE REGENERATION (10:50, 5 minut)

Prezenter: KOŁBUK-KONIECZNY, Dorota (Polish Academy of Sciences)

Cartilage injuries remain a major clinical challenge due to the tissue's limited self-healing capacity. Standard treatments, such as microfracture or autologous chondrocyte implantation, are often insufficient in restoring full function and structure of damaged cartilage. In this study, we present the SmartPiezo scaffold - a novel 3D printed, bio-based, and biodegradable construct designed specifically for cartilage regeneration, with integrated piezoelectric functionality to promote mechanotransduction and tissue remodeling. The primary goal of this work is to assess the feasibility of using bio-based polymeric materials in a scaffold fabricated via additive manufacturing, capable of delivering not only a suitable structural environment for chondrocyte growth but also a mechanical stimulus mimicking natural cartilage loading. SmartPiezo scaffolds were printed using GelMA with additives to enhance mechanical and piezoelectric properties. Preliminary results indicate that the SmartPiezo scaffold exhibits promising morphology illustrated by SEM for application in cartilage tissue engineering, combining biocompatibility with mechanical resilience and piezoelectric responsiveness. The research was support by the M-ERA.NET 3 2024 call, financed by the European Union's Horizon 2020 research and innovation programme under grant agreement no. 958174, through the National Science Centre no.2024/06/Y/ST11/00225 74734117884

3D PRINTED BIO-BASED SCAFFOLD FOR CARTILAGE REGENERATION

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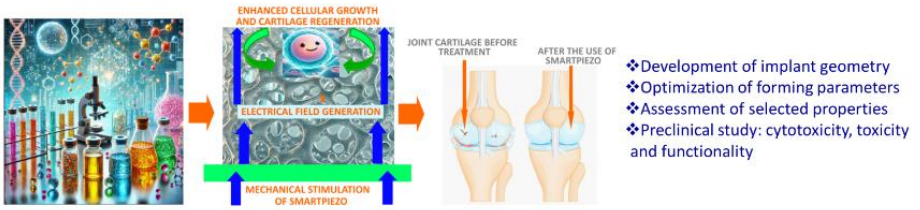
SMARTPIEZO project focuses on developing sPiezoBio, a bio-based piezoelectric osteochondral construct designed to address joint defects caused by trauma, osteoarthritis, arthritis, or cancer—conditions with limited regenerative solutions today. The project aims to create innovative scaffolds for joint defect filling and regeneration while also providing an in-vitro osteochondral tissue model to support drug and treatment testing, ultimately accelerating pharmaceutical development.
Our work begins with the optimization of GelMA synthesis and 3D printing to enable advanced biomedical applications.



- Development of implant geometry
- Optimization of forming parameters
- Assessment of selected properties
- Preclinical study: cytotoxicity, toxicity and functionality

GelMA synthesis and hydrogel printing

Gelatin type A (from porcine skin) was dissolved in PBS (10% w/v) at 50 °C under stirring. Methacrylic anhydride (0.8–1 mL per g gelatin) was added dropwise, and the reaction proceeded for 2–3 h at 50 °C. The solution was dialyzed (12–14 kDa MWCO) against deionized water for 7 days with daily water changes, then freeze-dried to obtain GelMA powder.
For hydrogel fabrication, GelMA was re-dissolved in PBS containing the photoinitiator irgacure 2959 (IR) and constructs were printed using the **BioCloner Health** bioprinter. Crosslinking was achieved by UV exposure (365 nm).

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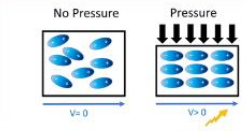

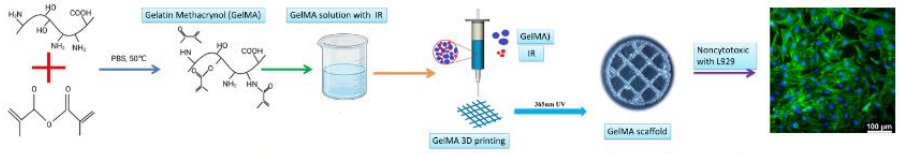

COOPERATION

INSTITUTE OF FUNDAMENTAL TECHNOLOGICAL RESEARCH, POLISH ACADEMY OF SCIENCES
RESEARCH INSTITUTE INNOVATIVE MEDICINE CENTRE (LT)
LATVIAN INSTITUTE OF ORGANIC SYNTHESIS (LV)
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