



5D printing of nano-laden fibre aerogel

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Abstract:

The organs functionality and the related material mimicry properties (Kokkinis) are difficult to reproduce. The smart design and reconstruction processes (Avventuroso; Wu) requires the material functionalization and engineering. To overcome these problems, we merged the composite biomaterials (Guarino; Milazzo) properties with the bio-composite manufacturing processes (Foresti). In fact, the composite biomaterial can modulate its properties with nanoparticles and the resulted bio-ink can be used for the fabrication of the fibre, the adhesive interface and the coating matrix of a bio-composite material. For example, with a flexible fibre covered with an adhesive coating (impermeable and unable to improve the cells adherence, avoiding occlusion problems) it is possible to develop a functional vessel (Hajal).

We reconstructed a femoral peripheral artery bifurcation utilising a patient morphology CT, obtaining a full customisable 5D printed object (Gillaspie). The resulted digital model was used to realise, with a custom made RFP bio-printer (Ozbolat), a sodium alginate-based (enriched with green fluorescent NPs) coating balloon gelled with EtOH, dehydrated (nano-laden fibre aerogel) and tested in-vitro. Furthermore, in-vivo tests (Fig. 1) with the bio-composite device demonstrated the uniform gradual release and a very short dissolution time ($\sim 2/3$ minutes).

Biography:

Ph.D. Ruben Foresti Postdoctoral Researcher in applied medical technical sciences at University of Parma. Research field addressed in 3D, 4D and 5D processes for digital fabrication of biomedical devices and customized scaffolds. PhD in Industrial Engineering at University of Parma. Design and implementation of additive manufacturing systems



for biomedical and food applications, including software and 3D model design. Expertise in rapid prototyping of automated systems with remote control including the design and the software development, electrical parts and mobile application. MSc. in Engineering Management and BSc. in Electronics Engineering. Co-founders of M3datek, academic spinoff.

Publication of speakers:

1. Alginate Formulations: Current Developments in the Race for Hydrogel-Based Cardiac Regeneration, May 2020
2. Smart Society and Artificial Intelligence: Big Data Scheduling and the Global Standard Method Applied to Smart Maintenance, Jan 2020
3. Highly-defined bioprinting of long-term vascularized scaffolds with Bio-Trap: complex geometry functionalization and process parameters with Computer Aided Tissue Engineering, Dec 2019
4. Bio composite materials: nano functionalization of 4D bio engineered scaffold, Sep 2019
5. Design of an instrumentation for the automated damage detection in ceilings, Nov 2017

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