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Abstract

Combination of laser additive manufacturing and Sol-Gel method for bone tissue regeneration silica-based scaffolds

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Laser additive manufacturing (LAM) is an established method to process additively metals and polymers, which is already available at the industrial level [1]. On the contrary, laser treatment implementation of ceramics is still a challenge due to low thermal shock resistance of the material, weak densification during processing, and strongly temperature-dependent absorptance of laser light [2]. Moreover, current manufacturing protocols require the use of polymer bindings to avoid cracks during the drying step [3].

In this work, we present a new polymer binder-free manufacture route for ceramic materials, which combines for first time the advantages of LAM and sol -gel method to obtain silica-based porous scaffolds for bone tissue regeneration. In a typical preparation, fumed silica and carbon nanotubes (CNTs) were dispersed in distilled water and mixed to obtain a sol, which was deposited layer by layer on a copper plate. After, each layer a laser treatment was applied using a Ytterbium fiber laser emitting at 1064 nm, working in a pulsed mode. Cracks free green specimens with a setup dimension of 4 × 4 mm^2 were obtained that were then sintered to both consolidate the specimens and eliminate the CNTs. Influence of the laser power and scanning speed as well as of the sintering conditions on the physico-chemical and mechanical properties of the final material were studied by optical and scanning electron microscopy, energy dispersive X-ray spectroscopy, X-ray diffraction, Fourier transform infrared spectroscopy, thermal analysis and micro hardness measurements.

Author's statement

Conflict of interest: Authors state no conflict of interest. Animal models: No animal experiments were carried out. Informed consent: Informed consent has been obtained from all individuals included in this study.

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