Advanced Additive Manufacturing of Biosilicate® Glass-ceramic Scaffolds

Hamada Elsayed[1]

[1]University of Padova (IT)

The Biosilicate® glass-ceramics are one of the most promising alternatives to the 45S5 Bioglass®, in terms of bioactivity, osteoconductivity, osteoinductivity, non-cytotoxicity, and antibacterial properties, with noteworthy advantages in the manufacturing of specific scaffolds with complex shapes for bone tissue engineering application. Moreover, the Biosilicate® glass-ceramics possess superior mechanical strength, owing to the crystallization of a Na–Ca silicate phase, that does not lead to a degradation of bioactivity, unlike in 45S5 Bioglass®. In the current research, we will explore the suitability of Biosilicate® glass-ceramic powders for fabricating highly porous bioactive scaffolds (porosity of 50–90 vol%) using different additive manufacturing technologies, such as direct ink writing (DIW) and digital light processing (DLP), as well as masked stereolithography (MSLA). In addition, we will discuss the feasibility of developing Biosilicate® glass-ceramics employing the polymer-derived ceramics (PDCs) approach as an alternative processing route. In particular, silicones, filled with active fillers in the form of fine powder and salts, were engineered as advanced feedstocks for the additive manufacturing of Biosilicate® glass-ceramics scaffolds. Engineered silicones and fillers also enabled the formulation of novel Biosilicate®/carbon composite scaffolds. The functionalization of Biosilicate® glass-ceramics scaffolds with carbon makes the developed composites promising for disinfection of bone-tissue implants and photothermal therapy.