PROTEINS AS COATING MATERIALS ON BIOACTIVE GLASS-BASED COMPOSITE FOAMS

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Nowadays the replacement or repair of tissue damaged by disease or trauma, especially bone tissue, is one of the biggest challenges in the medical field and is faced by thousands of surgeons every day. Autografts are the current gold standard but they are strongly limited which turns the spotlight to the application of alloplastic grafts which consist of non-biological engineered materials like metals, ceramics or polymers [1]. Due to the high bioactivity, osteoconductivity and angiogenic effects, bioactive glasses, e.g. the 45S5 Bioglass® composition, are attracting increasingly attention as bone substitute materials. However, the brittle character of bioactive glass limits its application area in bone tissue engineering, particularly in load-bearing parts. To improve the mechanical properties of bioactive glass-based foams (scaffolds) fabricated by the foam replica technique [2], polymer coatings are applied to fill and bridge microcracks present on the surface of the scaffolds in order to increase the fracture strength [3]. Zein, a plant-derived protein from corn, offers biodegradability and biocompatibility and is widely used as coating material in the pharmaceutical and food industry [4]. 45S5 bioactive glass-based scaffolds, dip-coated in a solution with 8 wt.% zein in ethanol, showed enhanced mechanical performance after the coating procedure. Compressive strength increased from 0.04 ± 0.02 MPa for uncoated scaffolds to 0.21 ± 0.02 MPa for zein-coated scaffolds. In contrast, an animal-derived protein was also used as coating material to compare the potential of natural-derived proteins of different origins for further investigations in the field of bone tissue engineering. Collagen is the most abundant protein in mammals and has the ability to form a strong network [5]. By surface functionalization collagen type I can be covalently bonded to the bioactive glass surface. Additional chemical crosslinking with NHS and EDC further strengthen the collagen coating. Samples coated with collagen showed as well enhanced mechanical performance and exhibited values of 0.18 ± 0.02 MPa for compressive strength. For the evaluation of bioactivity, uncoated and polymer-coated scaffolds (zein and collagen) were immersed in simulated body fluid (SBF). Results showed no influence of the coating material on the bioactive behavior of the 45S5 bioactive glass-based foam. Therefore, both natural-derived proteins have the potential to be used as coating materials for tissue engineering applications and are promising candidates for further comparative studies in this field.