STIFFNESS IMPROVEMENT OF 45S5 BIOGLASS®-BASED SCAFFOLDS THROUGH PCL AND COLLAGEN COATINGS: AN ULTRASONIC STUDY

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Introduction

Due to its excellent bioactivity, 45S5 Bioglass® is being highly considered in tissue engineering scaffold development. In order to enhance vascularization promoting tissue growth, these scaffolds typically exhibit a highly interconnected porous structure with a porosity between 80 and 90% (see Fig. 1). Often, Bioglass®-based scaffolds of such high porosity exhibit insufficient stiffness. In order to increase it scaffolds fabricated by the foam replica method, were coated with collagen, gelatin, polycaprolactone (PCL), alginates, and poly(L-lactic acid) (PLLA) [1–2]. The resulting stiffness gain was quantified by means of ultrasonic measurements [3, 4, 5, 6].

Imaging and ultrasonic measurements

Results

Both PCL and collagen coatings increase the overall scaffold’s stiffness (E¯ scaffold), as compared to uncoated scaffolds, by 58% and 38%, respectively; while no remarkable stiffness increase was recorded for the other coatings. To reveal the influence of the coatings’ stiffness (E¯ scaffold) on the overall scaffold’s stiffness (i.e. the micromechanical interactions patterns between Bioglass® and different coatings) a dimensionless relation between coating volume fraction and the ratio of E¯ scaffold/E¯ sample was investigated. Together with (E¯ scaffold/E¯ sample)-values stemming from ultrasonic experiments, theoretical values predicted applying the classical isotropic self-consistent micromechanics scheme [7, 8, 9, 10, 11] were taken into account (see Fig. 2).

The fact that the relation between coating volume fraction and the (E¯ scaffold/E¯ sample)-ratio are significantly different among chosen coatings indicates distinct micromechanical interactions patterns. Additionally, scanning electron microscopy (SEM), revealed that PCL (unlike collagen) did not clog the micropores of the as-fabricated scaffolds (which supports the thesis of different micromechanical interactions patterns), which are deemed essential for cell seeding and the resulting in-growth of bone tissue.

Acknowledgements

Financial support to Jasmin Hum by a research fellowship of KMM-VIN (www.kmm-vin.eu) is gratefully acknowledged. Moreover, Krzysztof Luczynski and Christian Hellmich are grateful for funding within the project MICROBONE (grant number 257023), granted by the European Research Council.

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