REMARKABLE IMPROVEMENT IN THE MECHANICAL PROPERTIES OF 3D PRINTED BIOGLASS SCAFFOLDS BY GRAPHENE

Siamak Eqtesadi[1]
Azadeh Motealleh[1]
Rune Wendelbo[1]
Angel Luis Ortiz[2]
Pedro Miranda Gonzalez[2]

1 Abalonyx AS, Forskningsveien 1, 0373 Oslo, Norway
2 Universidad deExtremadura, Badajoz, Spain

se@abalonyx.no

The 45S5 bioglass (Bioglass®) is one of the most widely used and well studied bioactive glasses [1]. spite of its good biological properties, the intrinsic brittleness of 45S5 bioglass as well as its low strength seriously limit the commercial applications of 45S5 scaffolds fabricated by conventional methods [2]. Robocasting, an extrusion-based additive manufacturing technique, has been recently used to enhance the mechanical properties of bioceramic scaffolds in general and of 45S5 [3]. Although robocasting has mitigated the weakness of 45S5 scaffolds, the intrinsic poor sinterability of 45S5 bioglass still limits the mechanical performance of 45S5 robocast scaffolds. The addition of a polymeric phase to the brittle robocast 45S5 bioglass scaffolds is a suitable solution for enhancing not only their strength but also their toughness. However this approach is not exempt from some disadvantages, regardless of whether one uses biodegradable synthetic or natural polymers. Graphene, a monolayer of carbon atoms arranged in a honeycomb lattice, has shown impressive thermal, mechanical, and electrical properties, and is a promising alternative as a reinforcement to tailor the material structure at nanometre scale in order to obtain stronger and tougher engineering ceramics With these premises in mind, in the present study, robocast 45S5 bioglass scaffolds were reinforced with graphene in order to enhance their mechanical properties for bone tissue engineering applications.

References

[1] L.L. Hench, R.J. Splinter, W.C. Allen, T.K. Greenlee, Bonding mechanisms at the interface of ceramic prosthetic materials, J. Biomed. Mater. Res. 5 (1971) 117–141.

[2] Q.Z. Chen, I.D. Thompson, A.R. Boccaccini, 45S5 Bioglass®-derived glass-ceramic scaffolds for bone tissue engineering, Biomaterials. 27 (2006) 2414–2425.

[3] S. Eqtesadi, A. Motealleh, P. Miranda, A. Pajares, A. Lemos, J.M.F. Ferreira, Robocasting of 45S5 bioactive glass scaffolds for bone tissue engineering, J. Eur. Ceram. Soc. 34 (2014) 107–118.

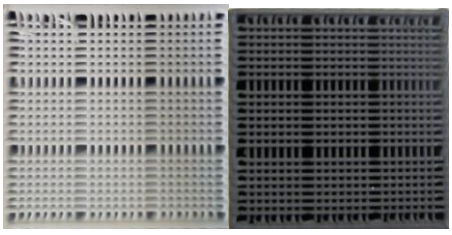

Figure 1: *Optical images of 3D porous scaffolds produced by robocasting from (Left) 45S5 BG and (Right) 45S5 BG-rGO inks, in their as-printed (non-sintered) condition. The difference in the color is due to presence of rGO in the 45S5 BG-rGO green body.*