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Guest Editors preface

# Exploring challenges ahead of nanotechnology for biomedicine

This special issue is dedicated to the selected papers of the 1st biennial International Conference BioMaH –**BioMa**terials for **H**ealthcare "Biomaterials for Tissue and Genetic Engineering and the Role of Nanotechnology" held in Rome (Italy) in October 17–20, 2016.

The special issue is focused on the new frontiers of bioactive materials facing challenges and embracing opportunities in the field of tissue regeneration and repair. The focus includes a wide range of chemical, physical, and biological aspects, with the scope of exploring emerging technologies for a large variety of engineered materials, their combinations, and interfaces with specific biofunctionality.

The issue consists of 8 papers covering different aspects related to smart biomaterials [1], materials for 3D printing applications [2], magnetic scaffolds [3], nanocomposites [4], bone cements [5] and several papers dedicated to biomedical coatings [6–8].

Authors [1] designed and synthesized h-vitronectin nanopeptides for glass surface covalent selective functionalization to improve the bioactivity and peptide's interaction with cells with the final goal to increase the osseointegration and implants' long-term success.

Advanced polymers and nanocomposites have been designed for the additive manufacturing approach [2,3], in order to develop 3D fully-interconnected custom made scaffolds for tissue engineering. The authors [2] developed an acrylic based copolymer suitable for stereolithography. The copolymer provides an intrinsic opportunity to tailor mechanical properties just by varying the amounts of the single acrylic components, while a poly(ethyleneglycol) was used as crosslinker. Calorimetric, static and dynamic mechanical analyses have been carried out to access thermal and mechanical performance. The single components of the copolymer are widely employed in the clinical practice, but they are considered as biologically inert biomaterials, thus preventing cell-material interactions suitable for tissue regeneration. For this reason, surface treatments have been explored for improving surface wettability and cell recognition of the synthesized copolymer. On the other hand, the fused deposition modelling was employed by the authors [3] to manufacture nanocomposite superparamagnetic scaffolds based on poly(caprolactone). Beside the well-known opportunity to provide an intrinsic signal through nano-hydroxyapatite to cells colonizing the scaffold, these fully degradable and morphologically controlled architectures incorporate a unique magnetic feature. Using a magnetic bioreactor the effects of a static or a dynamic field on the scaffold-mesenchymal stem cells interaction have been explored opening new perspectives for the application of magnetic fields and cell-laden scaffolds for tissue engineering. The authors [4] synthesized a hydroxyapatite nanorod-reinforced poly(caprolactone) through a solvothermal process. It has been shown that this *in-situ* process allows one to realise highly porous nanocomposite scaffolds with properties superior than those of similar scaffolds obtained through the conventional blending technique between polymer and nanoroads, and *in vitro* investigations suggest that these scaffolds are suitable for the regeneration of tissues in orthopaedics and maxillofacial surgery.

A variety of nanocomposites incorporating nanoparticles with antimicrobial activity are emerging as a new class of biomedical materials for preventing premature failure of cemented implants due to bacterial proliferation. Silver nanoparticles embedded in bone cements represent the most popular choice. Instead, the authors [5] performed preliminary analysis of the mechanical and antibacterial activity of a bone cement loaded with gold nanoparticles. The obtained results demonstrated that nanocomposite cements with a specific concentration of gold nanoparticles improved the punching performance and antibacterial activity.

Several papers of this special issue deal with coating materials obtained employing various coatings methods. In the article [6], different bioceramic materials were combined with metals (Cu, Ag) possessing antibacterial properties, in order to test them as implant coatings offering enhanced biocompatibility as well as infection prophylaxis. To produce metal-doped bioceramic coatings, the authors [6] used high velocity suspension flame spraying. The authors [7] applied radio-frequency magnetron-sputtering technique to prepare bioactive calcium phosphate coatings. The biphasic hydroxyapatite and tricalcium phosphate targets sintered at different mass ratios were used for this purpose. The structure, composition and morphology of coatings were controlled by the biphasic target composition. The micro-arc oxidation technique was employed in Ref. [8] to deposit biocompatible coatings with gradient structure, rough and porous morphology. The presented results are related to the structure and properties of wollastonite-calcium phosphate coatings deposited on Ti and Zr-Nb alloy.

We greatly appreciate the contribution of all the authors that participated in this special issue.

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