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Editorial: Challenges and Solutions in the Production of Advanced Nanostructured Biomaterials for Medical Applications

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Editorial on the Research Topic

Challenges and Solutions in the Production of Advanced Nanostructured Biomaterials for Medical Applications

Nanoparticles, nanocarriers, and nanostructured materials are largely used in biomedical and pharmaceutical applications, and for smart implantable and/or interactive systems adopted in regenerative medicine. Responsive nanosized materials, even multi-purpose designed, are currently employed to detect biologically and environmentally relevant analytes in therapeutic drug delivery and bioimaging and diagnostic techniques. However, their traditional production techniques suffer from numerous limits, such as: 1) long processing times, 2) use of toxic organic solvents and their residues in the final products, 3) collapse of the micro- and nanostructure during processing, 4) particle aggregation phenomena, etc. In this context, the selection of biocompatible and biodegradable materials, as well as of a proper production process, is crucial to enhance and to make effective the final performance of the bio-device.

This research topic has collected some examples of challenging materials to be used in the medical field. In particular, the preparation of graphene nanosheets reinforced zinc matrix composites by spark plasma sintering (Dai et al.), advanced drug delivery systems formed by polysaccharide-based (i.e., agarose, alginate, and chitosan) aerogels (Guastaferro et al.), and the production of luminescent Zn (II)-based nanoprobes to detect biologically and environmentally relevant analytes in therapeutic drug delivery, and for bioimaging and diagnostic techniques (Diana et al.), have been described and critically discussed.

Dai et al. showed as graphene nanosheets can significantly improve the mechanical properties of zinc matrices and, at the same time, can accelerate the degradation rate of these metal-based composites, depending on the content of the filler. Thanks to these features, an ideal composite degradation rate for orthopedic implant material was found. Guastaferro et al. proposed an innovative drying process, assisted by supercritical CO_2, as a promising technique to produce nanostructured solvent-free natural aerogels. Specifically, bio-based aerogels are supposed to be intriguing candidates as drug carriers, thanks to the native nanoporosity and the high specific surface area. These properties allow to reach a high drug loading and to obtain a sustained drug release over time. Diana et al. demonstrated that highly engineered symmetric systems, constituted of zinc (II) atoms as the metal nodes of hybrid organic-inorganic supramolecular structures, can be successfully applied for living cell bioimaging. In this review, a selection of significant cutting-edge articles

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collected in the last 5 years has been discussed, based on the structural pattern and sensing performance, with special notice to living cell bioimaging as the most targeted and desirable application.

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