Biotechnology Journal
www.biotechnology-journal.com

Nanomaterials for Biomedical Applications

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Nanotechnology has enabled the development of cutting-edge applications in the fields of biotechnology and bioengineering. Such an impact has emerged in a plethora of technologies and devices targeted at more effective disease diagnosis, monitoring, and treatment.

In this special issue, nanostructured materials in different shapes and assembly scales are suggested for healthcare applications. Zhou et al. provide a review of recent advances in the fabrication of flexible sensors taking advantage of functional nanomaterials.[1] Kargozar et al. provide a review on the role of quantum dots, with a focus on in vitro and in vivo studies, as well as a discussion about the clinical translation of these structures.[2] Increasing the focus on the therapeutic potential of nanomaterials, the requests for the development of biocompatible devices for tissue regeneration or replacement are investigated by Raut et al.[3] Discussion on tissue regeneration continues with a review by Abdollahiyan et al. on printing technologies to regenerate the osteochondral interface,[4] as well as with the report by Tolba et al. on amorphous inorganic nanoparticles capable of improving self-healing properties of both construction and medical cements.[5] Besides their promising role as pro-regenerative units, nanomaterials have also gained momentum as tools to treat tumors. Correia et al. evidenced the importance of using biomimetic 3D cellular aggregates as in vitro tumor models by studying the role of sulfobetaine methacrylate functionalized nanoparticles as enablers of combined photochemotherapy.[6] Peptide-based nanomaterials are also highlighted in this special issue by Deso et al., who addressed multi-layered nanocomposites for near-infrared light-triggered release of drugs to treat breast cancer.[7] Finally, the rising field of immunoengineering is addressed by Demircan et al. through the development of antigen-presenting self-assembled peptides with the potential to be used as vaccines for viral infections or to target cancer cells.[8] Cui et al. review self-assembled nanoparticles as platforms for vaccine development.[9]

Also, the preparation of nanostructures through self-assembly and engineering of natural substances such as peptides, magnetosomes, and exosomes is introduced,[10–12] In these reports, the successful fabrication of nanovesicles with better affinity and stability for cancer cell targets is suggested with magnetic reactivity or tissue-regeneration potential. Another example is the use of the physalis mottle virus nanoparticles for intelligent delivery of an anti-cancer drug.[13] There are reports on siRNA delivery using artificial nanostructures and cellulose nanocomposite synthesis techniques in Parkinson's disease research.[14,15] Those studies introduced an important system for the delivery of therapeutic agents in disease models in the future. A novel technology for selective isolation of biomolecules through the separation of nanomaterials using dielectrophoresis is also reported.[16] In this study, the successful engineering of Janus nanoparticles and dielectrophoretic electrodes provides precise separation of targets and it would facilitate the detection of very small amounts of biomolecular substances attached to nanomaterials.

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Bioimaging is one of the central techniques in life sciences, for which probes are essential and often greatly impact the performance of a bioimaging technique. Nanotechnologists have been developing various kinds of nanoparticles with unique physical properties and corresponding strategies for biofunctionalization of these novel probes, opening new possibilities for improvement or revolution of bioimaging. Wang et al. summarize the current state-of-the-art hybrid optical probes for neural membrane potential imaging, which is one of the major challenges in neuroscience research.[17]

All the papers in this special issue are state-of-the-art research and review articles. We expect it to be helpful for researchers in biomedical engineering and nanoscience. We hope our readers will enjoy it and find here the latest trends in biomedical applications of nanomaterials.

The ORCID identification number(s) for the author(s) of this article can be found under https://doi.org/10.1002/biot.202000574

DOI: 10.1002/biot.202000574

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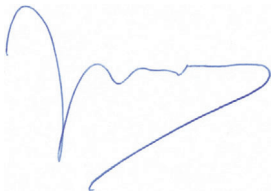

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