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Editorial

The Potential of Nanomaterials for Drug Delivery, Cell Tracking, and Regenerative Medicine 2013

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Nanomaterials are already revolutionizing medical treatments and diagnostics and could have the potential to diagnose and treat various life-threatening diseases. Well advanced technologies that have become possible, thanks to the properties of materials at the nanoscale, are the application of magnetic and gadolinium oxide nanoparticles in MRI imaging, magnetic immunoassays, magnetic hyperthermia, the use of drug nanosuspensions to improve drug dissolution and bioavailability, and many others. Various nanoscale carriers have been developed and are currently being explored for targeted delivery of therapeutics in order to increase the efficacy of the drugs and eliminate problems such as systemic toxicity. Nanoengineered scaffolds produced by various traditional and innovative techniques may give the opportunity to regenerate tissues and organs. The potential of nanoscale systems to bring healthcare treatments to a new dimension has galvanized research in this field and new applications are being reported almost every week. The aim of this special issue is to present some of the exciting new developments in the field, highlight current challenges, and point towards future directions.

This special issue contains a collection of excellent contributions from established laboratories around the world. It contains instructive reviews and original research articles dealing with the diverse areas that are the subject of this special issue.

Three excellent reviews were published in this special issue. These reviews present comprehensive summaries of the recent developments in the particular field, critical assessment of published literature, and the authors' prospective of the future directions. A review from the group of K. Ostrikov deals with the challenges associated with controlling the behavior of stem cells. The review focuses on using plasma-based techniques for the manufacturing and modification of tailored nanostructured surfaces for stem cell control. The review also provides the authors' views on the links between plasma physics, materials science, nanoscience, and stem cell biology. Another excellent review by J. E. Jackson et al. focuses on the use of nanoparticles as novel drug carriers in wound repair and regeneration. The authors' motivation for writing this review is the growing number of antibiotic-resistant bacteria, in conjunction with an increase in population age and clinical obesity that urgently requires novel, more efficient methods for wound care. The review critically discusses the advantages and limitations of nanotechnology for the treatment of wounds and other cutaneous disorders. Another review published in the special issue focuses on nanoparticle-based drug delivery for treating lung cancer. This review summarizes current progress in nanoparticle-based drug delivery systems that target lung cancer treatment. The review further outlines the challenges in the areas of pharmacology, toxicology, immunology, large-scale manufacturing, and regulatory issues that hinder the transition of these new therapies from the bench to the bedside.

Fourteen quality research articles were selected for publication in this special issue. Several of these articles tackle

problems related to drug delivery and offer innovative solutions. M. Fathi et al. present novel caffeic acid nanocarriers. The problems with improving the solubility of poorly soluble drugs through nanosuspensions are addressed by R. Yadollahi et al. In another article, X. Wang and coworkers report a novel magnetic-membrane-based microfluidic platform for controllable release. pH responsive polymeric micelles for delivery of hydrophobic drug are described by B. A. Moosa et al. Infections are an important problem with medical treatments. An article by M. Seidenstuecker et al. is focused on the release kinetics and antibacterial efficacy of microporous β TCP coatings. B. M. Sahoo et al. report on the microwave enhanced drug synthesis as an enabling technology to synthesize potential antimicrobial agents. The special issue also contains articles presenting novel opportunities for regenerative medicine. An *in vivo* study on the use of electrospun nanofibrous scaffolds for ligament-bone healing is provided by J. Zhu et al. The group of Y. Cong from Peking University reports on the fabrication of conductive polypyrrole nanofibers by electrospinning. M. Larsson et al. report on novel "*Nanocomposites of polyacrylic acid nanogels and biodegradable polyhydroxybutyrate for bone regeneration and drug delivery.*" The special issue also contains an interesting article entitled "*Magnetic and structural studies of $CoFe_2O_4$ nanoparticles suspended in an organic liquid.*" The authors suggest that these nanoparticles can be of interest for medical imaging. Surface properties have been recognized as important mediators of cellular behavior. The role of substrate topography in endothelial cell proliferation is elucidated in an article entitled "*Enhanced Ca^{2+} entry and tyrosine phosphorylation mediate nanostructure-induced endothelial proliferation.*" The issues of potential hazards associated with the use of nanomaterials in medicine are also embedded in the special issue via an article by V. Balakrishnan et al. entitled "*In vitro evaluation of cytotoxicity of colloidal amorphous silica nanoparticles designed for drug delivery on human cell lines*."

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