This special section of the Journal of Materials Research contains articles that were accepted in response to an invitation for manuscripts.

Introduction

Guest Editors:

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The past few years have witnessed major growth in the use of semiconductor nanoparticles for diagnostic and therapeutic applications in the fields of biosensing and biomedicine. The tremendous progress in the field of nanotechnology has generated many techniques for the fabrication of semiconductor nanostructures with controlled composition, tailored properties, and multiple functionalities[1], and a diverse set of surface chemical reactions have been developed to allow their integration into biological systems[2,3]. With physical dimensions comparable to many common biomolecules, semiconductor nanostructures are also employed in many hybrid nanoparticle-biomolecule systems[4]. Silicon and silicon-based nanoparticles possess unique properties important for biosensing and biomedicine applications, including low toxicity, biocompatibility, stable photoluminescence, dissolution *in vivo*, and earth-abundance.

This special Focus Section of the *Journal of Materials Research* brings together current developments in the fields of biosensing and biomedicine using silicon-based nanoparticles and nanostructures, including porous and non-porous silicon nanoparticles, mesoporous silicon oxide, and other nanostructured silicon compounds. D. Kapusuz and C. Durucan present a general method for the encapsulation of DNA molecules in silica hosts, and propose a DNA encapsulation mechanism correlating the silica microstructure and the DNA holding efficiency. K. Jiang and J. L. Coffer discuss the fabrication of silicon nanowire/polycaprolactone composites by straightforward embedding-printing methods and evaluate their cytocompatibility with a bone-relevant cell line derived from mouse stroma.

In spite of the experimental difficulties associated with the control of photoluminescence, silicon nanocrystals show interesting features that allow them to be used efficiently as fluorescent biomarkers. In this regard, the application of silicon-based nanoparticles in the field of bioimaging, as well as possible future developments, is reviewed by E. Borsella, R. D'Amato, M. Falconieri, E. Trave, A. Panariti, and Ilaria Rivolta. The development of nanostructured biomarkers is also discussed by D. Beke, Zs. Szekrényes, D. Pálfi, G. Róna, I. Balogh, P. Maák, G. Katona, Zs. Czigány, K. Kamarás, B. Rózsa, L. Buday, B. Vértessy, and A. Gali, who report a method, based on electroless wet chemical etching, for the fabrication of silicon carbide quantum dots. They also report on the cytotoxic properties of this interesting new class of nanoparticles. N. Elhalawany, Y. Maximenko, Z. Yamani, S.-T. Yau, and M. H. Nayfeh describe the use of a "miniemulsion" to synthesize novel water-soluble dispersions of nanocapsules containing polyaniline shells and luminescent, ultrasmall silicon nanoparticle cores and the functionalization of the resulting materials is also described. S.-K. Chiu, B.A. Manhat, W.J.I. DeBenedetti, A.L. Brown, K. Fichter, T. Vu, M. Eastman, J. Jiao, and A.M. Goforth demonstrate the preservation of the red emission from silicon nanoparticles in aqueous biological media and examine the effect of pH on the emission color in cellular imaging.

Porous silicon is currently a topic of intense research activity. A. Tzur-Balter, A. Rubinski, and E. Segal describe the fabrication of porous silicon nanoparticles for their use as tunable delivery carriers for the model anti-cancer drug, mitoxantrone dihydrochloride. They discuss, *in-vitro* cytotoxicity studies on human breast carcinoma cells which demonstrate that the released anti-cancer drug maintains its cytotoxic functionality. H. A. Santos, L. M. Bimbo, B. Herranz, M.-A. Shahbazi, J. Hirvonen, and J. Salonen review the recent innovative diagnostic imaging aspects of porous silicon, emphasizing its potential for the development of theranostic platforms and tools for the clinic.

The eight papers included in this Focus Section provide an excellent view of current research activity on the use of silicon-based nanoparticles in the broad areas of biosensing and biomedicine. These fields are expected to show significant activity in the coming years, as they are considered strategic research priorities by many national research programs.

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DOI: 10.1557/jmr.2012.400

