Guest Editorial Special Section on Advances in NanoBioEngineering ICNBE 2018

THE Engineering Sciences for Biology and Medicine (ESBM) is the world's largest international society of biomedical engineers, which provides a platform for researchers all over the world to share ideas and knowledge regarding the development and applications of engineering concepts and methods toward the solution of biological, medical, and healthcare problems. In 2018, the *IEEE EMBS R9 Monterrey Chapter* co-sponsored the first edition of the International Congress on NanoBioEngineering (ICNBE'18), organized by the Universidad Autonoma de Nuevo Leon through the School of Chemical Sciences, as the inaugural event of their new Research Center on Biotechnology and Nanotechnology (CIByN). This event was held at the Research Center on Biotechnology and Nanotechnology (CIByN), in Monterrey, Mexico, from the November 7–9, 2018. The ICNBE'18 served as an initial platform to foster interactions between scientists, engineers, and medical researchers and to discuss the advances and future applications of NanoBioEngineering Research. At the ICNBE'18, there were 10 plenary conferences imparted by globally recognized scientists in the fields of nanotechnology, biotechnology, and engineering; there was also a discussion forum on the relevance of interdisciplinary research between these three areas of knowledge and their contribution to solving the most important global problems. In addition, there were more than 70 scientific conferences in oral mode, three specialized workshops, and more than 50 scientific posters were presented; all of these with the aim to encourage discussions and exchange of ideas on the following areas: NanoBioMaterials, Nanotechnology Systems, Nanotechnology and Nanoscience, NanoBioChemistry, Environment and Sustainable Energy, NanoBioMedicine, and NanoBioEngineering. The editors thank all the participants for their appreciated contributions. This special issue selected peer-reviewed articles submitted from the ICNBE'18, and a total of six articles were selected for publication at the IEEE TRANSACTIONS ON NANOBIOSCIENCE after the rigorous IEEE independent peer review process.

Nanotechnology and biotechnology are among the fields that have generated the most "hype" within the last 30 years regarding their potential contribution to technological development. It can be foreseen that research at the interface of these areas of knowledge will have a great impact in the progress of a wide range of fields, such as development of therapeutics, materials, and alterative and clean energy, and contribute to increase the world's food and water supplies. Nanotechnology pursues to design and synthesize nanometric structures and machines in a lego-like fashion, where each building block is an individual molecule. On the other hand, biotechnology is guided by the growing understanding that most cellular processes occur in the form of networks controlled by sensors, signals, and effectors. Furthermore, biotechnology believes that building these networks individually can lead to the ultimate goal of constructing living organisms, or parts of them, from scratch. Therefore, it is very interesting and worth exploring where these fields can benefit from one another. Initially, there is great potential for biotechnology to take advantage of the powerful characterization tools and sophisticated synthesis and fabrication techniques that have been developed, within the field of nanotechnology, to construct nanostructures and devices that interface organic and inorganic systems. On the other hand, biotechnology offers the understanding of genetic circuitry and biochemical processes that allow life in living organisms. Therefore, one can think that the solution to achieving organization and ordering of synthesized nanostructures lies perhaps in studying how biological systems have mastered self-assembly to build hierarchical systems through the use of weak intramolecular forces. The selected works in this special issue exemplify the high impact research and findings that can be achieved from the perfect rendezvous between nanotechnology and biotechnology. These selected works in this special issue describe very interesting findings that advance material science, the food industry, environmental applications, biological processes, development of therapeutics, and characterization methods and techniques.

The great piece of work by Solís-Arévalo *et al.* [Item 1) in the Appendix] tackles one of the main healthcare problems of our times, which is to reduce the rise in hospital acquired infections. The work synthesized, by electrospinning, non-toxic schizophyllan-polyvinyl alcohol (PVOH) membranes and incorporated *Hamamelis virginiana* extract as

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an antimicrobial agent against the most common strains that cause nosocomial infections (*S. aureus*, *P. aeruginosa*, and *C. albicans*).

García-Cruz *et al.* [Item 2) in the Appendix] describe a technology that aids both the environment and the agroindustry. Phytopathogenic bacteria are a great problem for the agroindustry since they can infect large areas of cultivated crops, leading to food shortage and economic losses. The article compares the use of two bactericidal agents and their combinations in order to provide a solution to this problem. They treat three phytopathogenic microorganisms with orange wax extracts, zinc ferrite nanoparticles, and the combination of both of these compounds in order to compare their effects. Their findings provide interesting results toward the design and formulation of biopesticides involving zinc ferrite nanoparticle suspensions in an orange wax extract.

Guzman-Ruiz *et al.* [Item 3) in the Appendix] describe a captivating technology that involves the design of a nanocarrier to treat the effects of Parkinson's disease. This disease is estimated to affect more than 6 million people of the global population, and it is the second most frequent neurodegenerative disorder. As described in the work, one of the main challenges in the treatment of this disease is the delivery of therapeutics since only a very low percentage of the drugs can reach the brain due to enzymatic digestion in the gastrointestinal tract and the presence of the blood-brain barrier (BBB). Therefore, their contribution is the development of a nanocarrier based on the design of silica nanoparticles that can be administered orally. Their findings demonstrate that silica nanoparticles at a size range between 100 and 200 nm are not only biocompatible but are able to provide stability and prevent enzymatic degradation of anti-Parkinsonian drugs during intestinal absorption. Therefore, their nanocarriers are a potential delivery agent of drugs into the brain to treat Parkinson's disease and other neurodegenerative diseases.

Bioprocesses are of great importance especially in waste water treatments. However, one of the main obstacles in a bioprocess is their low efficiencies, mostly due to the slow kinetics, governed by the adsorbent/adsorbate interactions. In the literature, there are various works that attempt to perform immobilization of microorganisms or enzymes in order to increase efficiencies in fermentations and bioadsorption processes; therefore, it is important to decipher the interaction mechanisms between the biological materials and the different immobilization materials. In this special issue, García Torres *et al.* [Item 4) in the Appendix] describe the interactions between cobalt ferrite magnetic nanoparticles and *Aspergillus niger* spores, producers of cellulases. The findings describe that the adsorption of the spores follow Langmuir and Freundlich mathematical adsorption models which provides insight into immobilization strategies for different applications, including waste water treatment processes.

Development of intelligent nanomaterials in order to have a control release of a biologically active molecules is one of the areas where nanotechnology and biotechnology have an overlap. Piña Barrera *et al.* [Item 5) in the Appendix] work at the interface of nano and bio to develop a technology that aids in the reduction of post-harvest fruit loss, one of the objectives of the Food and Agriculture Organization of the United Nations. This contribution to the special issue demonstrated the ability to use nanoencapsulated essential oil of *Thymus vulgaris* on *Vitis vinifera* as an alternative to the traditional methods to preserve the fruit. The prolonged release of the essential oil due to the nanoencapsulation allowed for a longer protection of the crops and, therefore, a longer shelf life. Therefore, the results described in this article provide an alternative to the preservation of horticultural products.

The last contribution of this special issue, by Ochoa-Vazquez *et al.* [Item 6) in the Appendix], is a perspective regarding the use of Surface-Enhanced Raman Spectroscopy (SERS) in combination with microfluidic devices to detect trace molecules and perform *in situ* analysis of biological samples. In the perspective, the authors highlight the ability of the combined techniques to analyze microorganisms one by one and perform individual analysis of populations to obtain behavior distributions instead of an average result. Furthermore, SERS and microfluidics have the capabilities of detecting a subset behavior of a population and sorting and counting the cells with the desired phenotypes. The coupling of both of these techniques, which overlap nanotechnology and biology, will lead to new discoveries in the fields of chemistry, biology, and medicine.

This set of articles that make up this special issue are a subset of the relevant and high-impact research that was discussed and presented at the ICNBE'18. We again thank all of the participants for their contributions and exhort them to keep working in NanoBioEngineering, since, as it was mentioned at the beginning of this editorial, interdisciplinary research at the interface of these fields will provide the knowledge and technology to solve the most important problems society is currently facing.

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