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Editorial

Biomedical Engineering: Materials, Devices, and Technological Innovation Continue to Build a Better Future for Humankind

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Biomedical engineering is a relatively new and exciting branch of life sciences that combines materials, devices, design, and problem-solving engineering with medical and biological sciences in order to improve healthcare treatments, including diagnosis, implantation, monitoring, and therapy. The interdisciplinary field of biomedical engineering is changing the ways in which people interact with the world. From prosthetic limbs to medicine-delivery technology, the pioneering work by biomedical scientists and engineers has been shaking the very foundations of traditional medicines and healthcare treatments. Moreover, the miniaturization of medical equipment has been a major breakthrough, facilitating the development of more advanced wearable devices, microneedles for drug-delivery systems, and mini-sensors for brain-controlled prosthetics. Many incredible achievements have been made in biomedical engineering technology in the last decade, including clustered regularly interspaced short palindromic repeats (CRISPR) gene editing, methods for targeting nucleic acids, and wearable or portable devices that are used for the diagnosis of cancers, infectious diseases, and ophthalmic conditions.

The bioengineering industry is also one of the fastest-growing sectors in the global economy. What many people may not realize is that the world market scale of biomedical materials and devices is now as large as that of the semiconductor industry, and its annual growth rate is expected to be even greater. Since the beginning of 21st century, biomedical engineering has been making dramatic progress in China, with the domestic market scale of biomedical materials and devices reaching 734 billion CNY in 2020.

The 9th World Biomaterials Congress was held in Chengdu, a historic city in China, nine years ago. As the Chairman of the Congress, Prof. Xingdong Zhang invited more than 3000 scientists and researchers from 57 countries and regions to present 2900 papers. Profs. William Bonfield and Hailing Tu co-chaired the summit forum of the Congress, in which experts from around the world discussed the key issues of prostheses, therapeutic biologicals, and imaging equipment. Since then, many collaboration projects have been carried out among international laboratories related to biomedical engineering, in areas such as brain science, wearable sensing technologies, recombinant human collagen, and osteoinduction active materials.

In this issue, we organized six commentaries on major trends in biomedical engineering. Prof. Antonios G. Mikos and coworker from Rice University highlight how machine learning and artificial intelligence promote the immediate and continued success of tissue engineering and concludes that harnessing the power of machine learning is the next step in the evolution of medical device technology. Prof. Rui L. Reis and coworkers from the University of Minho summarize the challenges encountered in the development of implantable biosensors and emphasize the role of tissue engineering in new strategies for more personalized and reliable implantable biosensors. Prof. Xiaosong Gu from Nantong University investigates biodegradable materials used in the repair of spinal cord injury and peripheral nerves, and propose five key elements in the search for new materials in tissue engineering. Prof. Yunbing Wang from Sichuan University provides insight into the use of various cardiovascular materials and devices for efficient cardiovascular disease treatments, such as vascular stents, drug-eluting balloons, heart valves, cardiac occluders, artificial grafts, and injectable hydrogels against heart failure. Prof. Xiaoguang Li and coworkers from Capital Medical University discuss the adult

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neurogenesis process, including proliferation, differentiation, and migration, along with the recently raised controversy concerning whether or not adult neurogenesis can occur in humans. Prof. Feng He and colleagues from Tianjin University review the potential uses of brain–computer interface (BCI) systems; they address some of the limitations and problems in BCI and further focus on research topics that are expected to overcome those challenges.

We hope that these commentaries can provide readers with information on recent developments in biomedical engineering and encourage more scientists and researchers to contribute to these active fields. Looking forward to the next 30 years, we believe that biomedical engineering holds the potential to pave the way for further technological developments and to help people live longer and better lives.