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EDITORIAL

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Biomedical Polymers——Escort for Human Health

Biomedical polymers are a kind of engineered materials used for disease diagnosis and treatment, tissue fixation, tissue or organ repair, or organ replacement to restore or enhance the related functions in humans.[1] Biomedical polymers are the earliest developed and most widely used materials in biomedicine and continue to evolve as an essential frontier field of polymer science in the 21st century. With the development of molecular biology, cell biology, immune biology, biomedical engineering, translational medicine, and other disciplines, the emerging biotechnologies, such as aggregation-induced emission (AIE), controlled delivery of bioactive molecules, gene delivery, viral vaccine, gene editing, and optogenetics, and the increasing clinical demands promote the booming development of biomedical polymers.

Biomedical polymer is a cutting-edge interdisciplinary subject of polymer, material, life science, and medicine. As a model of new discipline formed by multidisciplinary integration, its establishment lays a solid material foundation for improving biology, medicine, pharmacy, and so forth, promoting the progress of related disciplines. Success in this emerging area requires interdisciplinary collaboration, which has already become a new trend in promoting related scientific progress. In contrast to the conventional purpose of polymer materials, the design and optimization of biomedical polymers aim to diagnose and treat human diseases and are necessary to ensure human health.

The development of polymers is the source motive force for exploiting new biomedical polymers. The diversified design of new structural and functional monomers, the continuous emergence of new methods for controlled polymerization, the rapid development of supramolecular chemistry, and the constant progress of self-assembly theories and strategies inject fresh and infinite vitality into the development of biomedical polymers, making the design and preparation of polymer biomaterials with new structures and functions possible. At the same time, the demand and development of biomedical polymers, in turn, call for the continuous innovation and progress of methodologies and theories in polymer research. In addition, the applications of nanoscience and nanoengineering technologies, such as surface patterning and engineering design, three-dimensional (3D) printing, microfluidic manufacturing, and multi-module assembly, also fuel the rapid development of biomedical polymers and put forward higher requirements for their structures and properties.

The scientific problems and applications of biomedical polymers are closely related to biomedicine. The application of biomedical polymers is committed to solving biology, pharmacy, and medical engineering problems to ensure human life and health. Therefore, the continuous progress of basic research in biomedicine indicates the direction for the development of biomedical polymers. For example, the disclosure of lesion microenvironments provides the possibility for the development of bio-responsive biomedical polymers-based drug delivery system;[2] the research progress of tumor biology and clinical oncology facilitates the research of biomedical polymers in interfering with tumor microenvironments to develop rapidly;[3] the exploration of interaction between biomedical polymers and cells reveals the *in vivo* fate and accelerates the clinical application of biomedical polymers;[4] the advancement of immunology puts forward higher requirements for the immune effects of biomedical polymers;[5] the research achievements in the field of stem cells have promoted the research on the interaction between biomedical polymers and cells;[6] the rapid development of gene manipulation technologies from the recombinant gene, RNA interference, to gene editing has brought new opportunities for the applications of biomedical polymers.[7] At the same time, biomedical polymers are essential for developing new detection reagents, new drugs and drug formulations, tissue engineering scaffolds, medical devices, and other medical consumables. Their progress is significant for the research and development and clinical application of new drugs and medical devices, and promotes the advancement of biomedical-related industries ultimately.

Biomedical polymers will trend toward excellent performance, high matching, outstanding bioactivity, and strong adaptability to meet the growing needs of clinical medicine and cope with the new disease challenges. Among them, the adaptive biomedical polymers are the most potential development goals, which can dynamically evolve over time and space according to the requirements of different-stages physiological microenvironments of various biomedical scenes, and have a certain feedback regulation ability to meet the needs of biomedical processes better.

So far, the constant deterioration of the coronavirus disease 2019 (COVID-19) pandemic has severely affected society and economic development worldwide. In this context, it is of great strategic significance to vigorously develop the basic researches and technology transformation of the biomedical polymers, which is essential not only to improve the medical healthcare of humans but also to develop the cutting-edge biomedical industry in China. Biomedical polymer is a crucial part of the biomedical engineering industry, and interdisciplinary integration can serve as necessary means to strengthen and expand the industries. The basic research of biomedical polymers in China

started late, but now it is stepping into the ranks of the advanced international level as the significant progress has been made with the long-term and ongoing efforts and team cooperation of multidisciplinary scientific researchers, which will better protect the life and health of humans.

REFERENCES

1 Tian, H.; Tang, Z.; Zhuang, X.; Chen, X.; Jing, X. Biodegradable synthetic polymers: Preparation, functionalization and biomedical application. *Prog. Polym. Sci.* **2012**, *37*, 237–280.
2 Chen, J.; Jiang, Z.; Zhang, Y. S.; Ding, J.; Chen, X. Smart transformable nanoparticles for enhanced tumor theranostics. *Appl. Phys. Rev.* **2021**, *8*, 041321.
3 Huang, X.; Ding, L.; Liu, X.; Tong, R.; Ding, J.; Qian, Z.; Cai, L.; Zhang, P.; Li, D. Regulation of tumor microenvironment for pancreatic cancer therapy. *Biomaterials* **2021**, *270*, 120680.
4 Feng, X.; Xu, W.; Xu, X.; Li, G.; Ding, J.; Chen, X. Cystine proportion regulates fate of polypeptide nanogel as nanocarrier for chemotherapeutics. *Sci. China Chem.* **2021**, *64*, 293–301.
5 Wei, Q.; Su, Y.; Xin, H.; Zhang, L.; Ding, J.; Chen, X. Immunologically effective biomaterials. *ACS Appl. Mater. Interfaces* **2021**, *13*, 56719–56724.
6 Liu, Q.; Zheng, S.; Ye, K.; He, J.; Shen, Y.; Cui, S.; Huang, J.; Gu, Y.; Ding, J. Cell migration regulated by RGD nanospacing and enhanced under moderate cell adhesion on biomaterials. *Biomaterials* **2020**, *263*, 120327.
7 Kong, H.; Ju, E.; Yi, K.; Xu, W.; Lao, Y. H.; Cheng, D.; Zhang, Q.; Tao, Y.; Li, M.; Ding, J. Advanced nanotheranostics of CRISPR/Cas for Viral Hepatitis and Hepatocellular Carcinoma. *Adv. Sci.* **2021**, *8*, 2102051.

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