applied sciences

MDPI

Editorial

Editorial Introduction to the Special Issue "Biomaterials and Biofabrication"

Jangho Kim [1,*], Kyunghoon Kim [2,*] and Hong Nam Kim [3,*]

[1] Department of Rural and Biosystems Engineering, Chonnam National University, Yongbong-ro 77, Gwangju 61186, Korea
[2] School of Mechanical Engineering, Sungkyunkwan University (SKKU), 2066 Seobu-ro, Jangan-gu, Suwon, Gyeonggi-do 16419, Korea
[3] Center for BioMicrosystems, Brain Science Institute, Korea Institute of Science and Technology (KIST), 5, 14-gil, Hwarang-ro, Seongbuk-gu, Seoul 02792, Korea
* Correspondence: rain2000@jnu.ac.kr (J.K.); kenkim@skku.edu (K.K.); hongnam.kim@kist.re.kr (H.N.K.)

Received: 21 August 2020; Accepted: 10 September 2020; Published: 14 September 2020

This Special Issue "Biomaterials and Biofabrication" of *applied sciences* comprises 10 papers that are the latest advances in basic and application research in the field of biomaterials and biofabrication. Biomaterials have grown to be one of the most important academy and industry fields that can strongly contribute to major advances in human health [1–4]. More recently, biomaterials that can be used for enabling medical platforms in combination with biofabrication technologies have emerged as a powerful paradigm for the next generation of medicine [5–7].

In this Special Issue, we invited submissions exploring the latest advances in the field of biomaterials and biofabrication (e.g., cell and tissue engineering scaffolds, wearable medical sensors, micro- and nanomedicine, 3D bioprinting, biologically-inspired engineering, organ chips, bioelectronics, etc.). We originally attracted 15 submissions, among which 10 regular papers were selected for inclusion in *applied sciences* after a rigorous review process. The accepted papers illustrate the highly innovative and informative venue for essential and advanced scientific and engineering research in the fields of biomaterials and biofabrication.

Heo et al. introduce the most recent continuous glucose monitoring (CGM) sensors, showing a paradigm shift to painless, continuous, zero-finger-pricking measurement in blood glucose monitoring [8]. They suggest that although such innovation has brought CGM technology closer to realizing the artificial pancreas, discomfort and infection problems have arisen from short lifespans and open wounds. A fully implantable sensor with a longer-term lifespan will be considered as an alternative CGM sensor with high comfort and low running cost, which can represent the new era of continuous glucose monitoring.

Nam et al. review the 3D bioprinting-based organ-on-a-chip technologies with focus on the engineered respiratory systems that are increasingly threatened by high levels of environmental pollution [9]. Interestingly, they delineate the strategic approaches based on biomaterials and biofabrication to develop respiratory-physiology-on-a-chip that can recapitulate respiratory system in vitro. Additionally, challenges and future research directions are delineated to improve the mimicry of respiratory systems in terms of both structural and biological behaviors.

Souto et al. focus on the retina, a highly organized structure, which is considered to be "an approachable part of the brain" [10]. It is attracting the interest of development scientists, as it provides a model neurovascular system. Since the neuronal system is nonlinear and very intricate, it is thus instrumental to have a clear view of the neurophysiological and neuroanatomic processes and to take into account the underlying principles that govern the process of hardware transformation to produce an appropriate model that can be mapped on a physical device. To this end, they reviewed the recently used mathematical models to map a directed retinal network.

Shen et al. report the biomechanical performance of two types of dual-threaded pedicle screw by comparing their pullout strength with that of a single-threaded screw in relation to bone quality [11]. Four types of pedicle screw with different thread patterns were designed, demonstrating that the dual-threaded pedicle screws exhibited higher pullout strength in normal-quality bone and significantly lower pullout strength in compromised osteoporotic bone, although the double dual-threaded screw exhibited better pullout biomechanics in osteoporotic bone with bi-cortical bone.

Ho et al. present the green electrospinning technology with non-toxic solvents to be applicable in the fabrication of fibrous materials, while ensuring health and safety and environmental protection [12]. Based on the less harmful reagents, such as acetone and acetic acid, they fabricated electrospun polycaprolactone membranes, showing the good cell-scaffold interaction for various biomedical applications.

Lau et al. report the 3D printing polyetheretherketone (PEEK) disks coated with various ratios of ampicillin and vancomycin salts for enhanced antibacterial activities. Importantly, the results show that a simple and low-cost 3D printing method for the preparation of PEEK/antibiotic agents/poly(lactic-co-glycolic acid) (PLGA) platforms can be used as an enabling strategy for many applications in biomedical-related technology [13].

Ahn et al. describe the method to model biomechanical-stimuli-induced blood vessel compression in vitro within a polydimethylsiloxane microfluidic 3D microvascular tissue culture platform with an integrated pneumatically actuated compression mechanism [14]. Such platforms will be a powerful and accessible in vitro method of modeling microphysiological reactions of microvascular tissues to compressive stress, paving the way for further studies into vascular failure as a result of external stress.

Jang et al. develop the lithographically-fabricated nanopatterned scaffolds for bone tissue engineering [15]. Inspired by the aligned extracellular matrix and bioceramics in human bone tissue, they investigated the relative contributions of nanotopography and equine bone powders with human dental pulp stem cells to the osteogenesis. This simple method to achieve a suitable environment for osteogenesis via nanotopography and bone powder coating modulation may be regarded as a promising technique for biomedical membranes, which is widely used in dental and maxillofacial surgery applications.

Ku et al. propose the newly designed cell-laden thermosensitive chitosan hydrogel bioinks for 3D bioprinting applications [16]. In this work, they fabricated various types of chitosan-based 3D bioprinting hydrogels. It is concluded that these platforms can be good candidates for 3D bioprinting and would pave the way for patient-specific regenerative medicines.

Finally, Park et al. report the new dental implants fabricated by chitosan and graphene [17]. They developed graphene-chitosan hybrid dental implants (GC hybrid implants), showing the GC hybrid implant under the optimal condition (i.e., 1% GC hybrid implant) could significantly promote osteoblast proliferation while reducing biofilm formation and bacterial activity. They discuss the potential of using this GC hybrid implant as a new type of dental implant, which can offer an effective design for the fabrication of advanced dental implants.

To conclude, special gratitude and appreciation is extended to all the authors for their high-quality submissions and the anonymous reviewers for volunteering their time and expertise to evaluate the scientific merit of the submitted papers. Additionally, the Special Issue managing editor, Mr. Jeffrey Lu, deserves special thanks for his great effort and support in making this Special Issue successful. We hope that this Special Issue of *applied sciences* can highlight new contributions in the rapidly growing and exciting interdisciplinary field of biomaterials and biofabrication.

Author Contributions: J.K., K.K. and H.N.K. conceived, designed and wrote the editorial. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Acknowledgments: This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (NRF-2016M3A9B4919353, 2019M3A9H1103737 and 2019M3C1B7025092). This work was also supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIT) (No. 2018R1A2A3075013 and 2020R1A2C4002557).

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Gaharwar, A.K.; Singh, I.; Khademhosseini, A. Engineered biomaterials for in situ tissue regeneration. *Nat. Rev. Mater.* **2020**, 1–20. [CrossRef]
2. Kim, J.; Kim, H.N.; Lang, Y.; Pandit, A. Biologically inspired micro-and nanoengineering systems for functional and complex tissues. *Tissue Eng. Part A* **2014**, *20*, 2127–2130. [CrossRef] [PubMed]
3. Abdulghani, S.; Mitchell, G.R. Biomaterials for in situ tissue regeneration: A review. *Biomolecules* **2019**, *9*, 750. [CrossRef] [PubMed]
4. Christman, K.L. Biomaterials for tissue repair. *Science* **2019**, *363*, 340–341. [CrossRef] [PubMed]
5. Moroni, L.; Burdick, J.A.; Highley, C.; Lee, S.J.; Morimoto, Y.; Takeuchi, S.; Yoo, J.J. Biofabrication strategies for 3D in vitro models and regenerative medicine. *Nat. Rev. Mat.* **2018**, *3*, 21–37. [CrossRef] [PubMed]
6. Pedde, R.D.; Mirani, B.; Navaei, A.; Styan, T.; Wong, S.; Mehrali, M.; Thakur, A.; Mohtaram, N.K.; Bayati, A.; Dolatshahi-Pirouz, A. Emerging biofabrication strategies for engineering complex tissue constructs. *Adv. Mater.* **2017**, *29*, 1606061. [CrossRef] [PubMed]
7. Ionov, L. 4D biofabrication: Materials, methods, and applications. *Adv. Healthc. Mater.* **2018**, *7*, 1800412. [CrossRef] [PubMed]
8. Heo, Y.J.; Kim, S.-H. Toward long-term implantable glucose biosensors for clinical use. *Appl. Sci.* **2019**, *9*, 2158. [CrossRef]
9. Nam, H.; Choi, Y.-M.; Jang, J. Vascularized Lower Respiratory-Physiology-On-A-Chip. *Appl. Sci.* **2020**, *10*, 900. [CrossRef]
10. Souto, E.B.; Sanchez-Lopez, E.; Campos, J.R.; da Ana, R.; Espina, M.; Garcia, M.L.; Severino, P.; Batain, F.; FR Alves, T.; Crescencio, K.M. Retinal Drug Delivery: Rethinking Outcomes for the Efficient Replication of Retinal Behavior. *Appl. Sci.* **2020**, *10*, 4258. [CrossRef]
11. Shen, F.; Kim, H.-J.; Kang, K.-T.; Yeom, J.S. Comparison of the Pullout Strength of Pedicle Screws According to the Thread Design for Various Degrees of Bone Quality. *Appl. Sci.* **2019**, *9*, 1525. [CrossRef]
12. Ho, M.H.; Do, T.B.-T.; Dang, N.N.-T.; Le, A.N.-M.; Ta, H.T.-K.; Vo, T.V.; Nguyen, H.T. Effects of an Acetic Acid and Acetone Mixture on the Characteristics and Scaffold–Cell Interaction of Electrospun Polycaprolactone Membranes. *Appl. Sci.* **2019**, *9*, 4350. [CrossRef]
13. Lau, N.-C.; Tsai, M.-H.; Chen, D.W.; Chen, C.-H.; Cheng, K.-W. Preparation and characterization for antibacterial activities of 3D printing polyetheretherketone disks coated with various ratios of ampicillin and vancomycin salts. *Appl. Sci.* **2020**, *10*, 97. [CrossRef]
14. Ahn, J.; Lee, H.; Kang, H.; Choi, H.; Son, K.; Yu, J.; Lee, J.; Lim, J.; Park, D.; Cho, M. Pneumatically Actuated Microfluidic Platform for Reconstituting 3D Vascular Tissue Compression. *Appl. Sci.* **2020**, *10*, 2027. [CrossRef]
15. Jang, K.-J.; Kim, S.; Park, S.; Kim, W.; Gwon, Y.; Park, S.; Lim, K.-T.; Seonwoo, H.; Kim, J. Lithographically-Fabricated HA-Incorporated PCL Nanopatterned Patch for Tissue Engineering. *Appl. Sci.* **2020**, *10*, 2398. [CrossRef]
16. Ku, J.; Seonwoo, H.; Park, S.; Jang, K.-J.; Lee, J.; Lee, M.; Lim, J.W.; Kim, J.; Chung, J.H. Cell-laden Thermosensitive Chitosan Hydrogel Bioinks for 3D Bioprinting Applications. *Appl. Sci.* **2020**, *10*, 2455. [CrossRef]
17. Park, S.; Kim, H.; Choi, K.S.; Ji, M.-K.; Kim, S.; Gwon, Y.; Park, C.; Kim, J.; Lim, H.-P. Graphene–Chitosan Hybrid Dental Implants with Enhanced Antibacterial and Cell-Proliferation Properties. *Appl. Sci.* **2020**, *10*, 4888. [CrossRef]