Using biomaterials research to address the challenges raised by the COVID-19 pandemic

*Qian Wang**

In 2020, humans suffered the most tragic year in recent history due to the coronavirus disease 2019 (COVID-19) pandemic – the loss of millions of lives, the worldwide financial crisis, the polarization of domestic politics in many countries, the disruption of the international transportations, and the downturn in global collaborations. Each of us has experienced the fear, the powerlessness, the depression, and the sacrifice of individual freedoms. Now, thanks to the miracle breakthroughs of severe acute respiratory syndrome-associated coronavirus 2 (SARS-CoV-2) vaccines, we are seeing the light at the end of this long and dark tunnel.

But remember that the world is not going to eliminate SARS-CoV-2 anytime soon. Coronaviruses circulate all the time, co-evolving with humans and other animals, causing the common cold and other illnesses. New variants of SARS-CoV-2 will continuously evolve even with the vaccine and new treatments. And more importantly, new viruses, probably more lethal or more contagious, will emerge and be ready to ambush us in the near future. As biomaterials scientists, it is our moral obligation to learn the hard lessons from the COVID-19 pandemic and work on solutions to prevent future pandemics. With the lives of billions of people worldwide disrupted by the COVID-19 outbreak, while we are still grieving our losses, we cannot help asking ourselves this crucial question: ***What can we do to prepare ourselves for the next pandemic***?

Over the past 15 months, a huge amount of research has been published covering work on all aspects of SARS-CoV-2. The significance of translational research has been magnified by the urgency of the COVID-19 pandemic. In particular, innovation in biomaterials research has been the cornerstone of every aspect of prevention, diagnosis, treatment, and patient care during the pandemic. Many challenges and opportunities have arisen to be addressed by biomaterials research:

• Can we achieve a better understanding of the mechanics and stability of enveloped viruses? What are the basic experimental and theoretical tools for such kinds of study?

• What is the best way to study the physicochemical characteristics, including composition, aerodynamics, and drying behaviour, of respiratory droplets? Such droplets represent a complex and multicomponent soft matter system, yet related studies are scarce.

• How should we systematically investigate virus–surface interactions, especially in complex aerodynamic environments? This is the key to controlling and monitoring virus transmission in an indoor environment, such as a hospital or residential area. It is also the key to developing better personal protective equipment and to identifying more effective approaches to enrich viruses for diagnostic purposes.

• How can the manufacturing technologies for biomaterials be further improved, for the development of biosensors, vaccines, protein/antibody-based medicines, and other medical supplies?

• How can the formulation of vaccines be streamlined and optimized, to further stimulate positive immunization, lower the toxicity and side effects, and improve vaccine stability?

• Can we use artificial intelligence or other cutting-edge technologies to realize the rationale behind materials design and characterization, to innovate new materials, and to accelerate biomaterials research and development?

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Biomaterials Translational is joining the global scientific community in the response to the challenges of COVID-19 by publishing this themed issue – "***COVID-19: Challenges and Opportunities to Biomaterials Science and Translational Medicine***". This collection of papers introduces several significant contributions that biomaterials scientists can bring to this emerging global crisis and point to specific opportunities for the biomaterials community to contribute.

The review article by Ge and Sheng[1] provides an overview of the transmission pathways of

Department of Chemistry and Biochemistry, University of South Carolina, Columbia, SC, USA

***Corresponding author:**
Qian Wang,
Wang263@mailbox.sc.edu;
qian.wang@biomat-trans.com.

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respiratory tract viruses as well as the structure and composition of the virus-laden respiratory droplets, and then discusses research opportunities for physical/materials scientists. Seong et al.[2] report the results of a preliminary investigation into the fate and transport of enveloped viruses in indoor built spaces, highlighting the importance of converging different fields of research to assess the fate and transport of microbes. The review by Jatoi and Fan[3] provides a biomaterials viewpoint of the 2020 SARS-CoV-2 vaccine development. Rattanapisit et al.[4] report the accelerated development of a diagnostic kit for SARS-CoV-2 using a plant-based recombinant protein expression system, a showcase of how innovative biotechnology can advance onsite clinical applications. Furthermore, the essay from Buranasudja et al.[5] provides a real-world story of the development of personal protective equipment in Thailand, highlighting the significance of collaborative efforts between the government, regulator, business sector, and universities in facing the major health system crisis arising from the COVID-19 pandemic. Finally, the review from Wang et al.[6] introduces the recent development of recombinant adeno-associated virus-based gene therapies, revealing how we can transform viruses from parasites to beneficial medical use.

While the COVID-19 pandemic has exposed the limitations in our ability to mitigate the transmission of infectious viral disease, we should have learned that the only way to prevail is to increase the transparency of communication, to improve public awareness and trust in science and education, and to continue with interdisciplinary and international collaborations, all of which contribute to accelerate innovative and translational research. Therefore, it is the goal of this journal, ***Biomaterials Translational***, to provide a platform for scientists and clinicians to contribute to this imperative endeavour.

Qian Wang is an Editorial Board member of Biomaterials Translational.

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