Organ-on-a-Chip for the Substitution of Animal Tests

Time: 10:30am, 18 October 2023 (Wednesday)
Venue: ERB1118, William M.W. Mong Engineering Building

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Abstract

Organs-on-a-chip (OOC) system, or microphysiological system (MPS), is a new type of biomedical research method that aims to recapitulate organ-level tissue structures and functions for drug evaluation and disease modeling. The MPS can be used to simulate the microstructure, microenvironment, and functional features of human organs, and applied in drug screening and clinical diagnosis and treatment. In previous studies, we have developed multiple organ-on-a-chip systems including biomimetic blood vessels, kidney, liver, heart, etc. Our previous work demonstrated that the miniature organs made with advanced microfabrication, 3D printing, microfluidics and tissue engineering techniques could form tissue-specific structures and could maintain some desirable organ functions for drug screening and disease modeling purposes. In this presentation, we report the development of a two-photon/multi-photon based 3D printing systems for the OOC fabrication and microenvironment formation, and the fabrication of multiple microphysiological systems for disease modeling, and the development of an automated high-content organs-on-a-chip imaging system for automated drug screening together with deep-learning based AI-algorisms for data analysis. The systems that we reported here have been widely applied in drug discovery and toxicity evaluation in collaboration with top-tier pharmaceutical companies in China, and have been used for precision medicine in collaboration with top-tier hospitals. We also report the design and development of a functional Lung-on-a-Chip system for lung bacterial/viral infection, inflammation studies. Lastly, our system and platform have been successfully applied in Covid-19 and other virus infectiousness evaluation, testing of the efficacy of drugs, neutralizing antibodies (including vaccines from Pfizer, BioNTech, etc.), and other protective measures. In summary, our work demonstrated the usefulness and progressive applications of OOC in multidisciplinary fields in China.

Biography

Prof. Gu serves as the Director of the National Key Laboratory of Digital Medical Engineering and the Dean of the School of Biological Science and Medical Engineering at Southeast University. Professor Gu has published over 100 significant papers in the field of organ-on-chip technology, which has not only attracted widespread attention in the academic community but has also made significant contributions to the technological advancement of this domain. His research covers a diverse range of aspects, including organ-on-chip design and fabrication, application of biomaterials, and microfluidic technologies, providing a solid foundation for driving the cutting-edge progress of organ-on-a-chip technology. He led a team that successfully developed China's first spaceborne vascular chip, offering a vital tool for aerospace medical research. He also advocated for the establishment of China's first skin chip standard, actively contributing to the standardization and normalization of the organ-on-chip field. Additionally, he spearheaded the approval of China's first clinical trial of a new drug based on data from heart-on-chip technology, marking a significant breakthrough in driving innovation and development within the pharmaceutical industry. Prof. Gu has received numerous awards, including the First Prize in Natural Science from the Ministry of Education, the First Prize for Teaching Achievements in Jiangsu Province, and the Outstanding Prize in the First National Technology Innovation Contest organized by the Ministry of Science and Technology. He has also led key scientific research projects, including those funded by the National Key R&D Program and the National Natural Science Foundation of China.

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