Artificial Organ: A Science and Technology With Great Impacts On Biotech Industry and Medical Applications

BIOGRAPHY

Dr. Dayong Gao is the Professor and Director of the Center for Cryo-Biomedical Engineering and Artificial Organs in the Department of Mechanical Engineering, and an Adjunct Professor in the Department of Bioengineering and the Kidney Research Institute, University of Washington (UW), Seattle, WA (2004 - present). Prior to joining UW, Dr. Gao was the Baxter Healthcare Chair in Engineering and the UK Alumni Professor in the Department of Mechanical Engineering and the Center for Biomedical Engineering, University of Kentucky, Lexington, KY.

Over the past 30 years, Dr. Gao's research has primarily focused on the following interdisciplinary fields: **(1) cryo-biomedical engineering**: (a) investigating the physical and biological mechanisms which determine the life-or-death of living biomaterials at low temperatures, and (b) developing novel technology and methods for long-term cryopreservation of living cells and tissues for cellular-gene therapy, organ transplantation, regenerative medicine, tissue engineering, new vaccine/drug development, disease screening, in vitro fertilization, and conservation of endangered species; **(2) artificial organs**: pioneering instruments and technology for treatment of the end-stage multi-organ-failure (MOF) diseases. For over two decades, Dr. Gao has directed a state-of-the-art research program to develop innovative artificial organ systems. In addition, his lab has been frequently used as a reference laboratory for international artificial organs and hemodialysis industries (e.g., Baxter International Inc., Gambro Healthcare, Inc, NxStage Medical, Inc, Asahi Kasei Medical Co., Ltd.); and **(3) Micro-sensors** for rapid and cost-effective diagnosis of diseases with high sensitivity and specificity. Dr. Gao has published over 500 peer-reviewed research papers, over 32 chapters in 24 books, and over 25 US and international patents. He has advised and graduated over 100 graduate students (including over 40 Ph.D. students). His research has been supported by grants and awards from government funding agencies, foundations, and corporations.

Dr. Gao's achievements have been recognized nationally and internationally with numerous awards and honors. Besides, he was elected as the President (2024-2025) of the International Society for Biological and Environmental Repositories and the President (2017-2019) of the International Society for Cryobiology. He is the Member of the Washington State Academy of Sciences, and the Fellow of the International Academy of Medical and Biological Engineering, the American Institute of Medical and Biological Engineering, the American Society of Mechanical Engineers, and the International Society for Cryobiology. In honor of Dr. Dayong Gao, "The Dayong Gao Young Investigator Award" was named and established by the International Society for Cryobiology to recognize the most outstanding young cryobiologist and cryo-biomedical engineer in the world every year (since 2019).

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ABSTRACT

Human organ failure is the leading cause of death among critically ill patients. For examples, kidney disease, affecting over 20 million adults in the US, is the 8th leading cause of death in the US, and kidney failure has resulted in over 1.2 million deaths worldwide every year. Liver failure accounts for approximately 2 million deaths per year worldwide.

An extracorporeal artificial organ is a human-made machine or system which can be used to replace a natural organ's function(s) and to provide life support so that the patient can survive for a long time and return to a normal life or waiting for organ transplantation.

This seminar will (A) introduce the scientific and technological fundamentals of artificial organs with a focus on artificial kidney and liver; and (B) report the speaker's research and technological breakthroughs in (1) the Portable Artificial Kidney, and (2) the Artificial Multi-organ Replacement (AMOR) system to treat multi-organ failure patients. Recently, AMOR has been used for the treatment of ten ICU patients with more than 3-organ failures (including liver failure in common) in a clinical study at the University of Washington Medical Center. A significant clinical improvement was shown in all 10 patients whose lives were sustained by the AMOR, and half of them were able to proceed to the successful liver transplantation or spontaneous recovery. AMOR is a simple, effective, inexpensive, and versatile system that does not require special staff training. In addition, the AMOR was remarkably successful in removing large amounts of excess body fluid, which all currently-used hemodialysis machines could not achieve, leading to improvement in pulmonary and cardiac function. Thus, the AMOR system was able to support liver, kidney, lungs, and heart.