Molecular Understanding, Design and Development of Zwitterionic Materials

An important challenge in many applications, ranging from drug delivery carriers to medical devices, is the prevention of nonspecific protein adsorption on surfaces. To address this challenge, our goals are twofold. First, we strive to provide a fundamental understanding of nonfouling mechanisms at the molecular level. Second, we aim to develop biocompatible and environmentally benign ultra low fouling materials based on the molecular principles we have learned. Over the last 18 years, we have demonstrated that zwitterionic and mixed charge polymers and peptides, derived from naturally occurring zwitterions, are highly resistant to nonspecific protein adsorption, cell adhesion and bacteria adhesion/biofilm formation from complex media. Both simulation and experimental results indicate that the strong hydration of zwitterionic materials is responsible for their excellent nonfouling properties. Recent results show that zwitterionic materials do not induce immunological response in blood circulation and capsule formation upon implantation and are able to preserve protein and cell bioactivity. Zwitterionic materials have been shown to be superior to poly(ethylene glycol) (PEG)-based materials for a number of biomedical and engineering applications such as drug delivery carriers, medical devices, implantable materials, cell therapeutics, and marine coatings.

About the Speaker

Professor Jiang received his Ph.D. degree from Cornell University in 1993 in chemical engineering. He was a postdoctoral fellow at the University of California, Berkeley between 1993 and 1994 and a research fellow at California Institute of Technology between 1994 and 1996 both in chemistry. He is currently the Boeing-Roundhill Professor in the Department of Chemical Engineering and an adjunct professor of Bioengineering at the University of Washington, Seattle. He was a visiting professor in the Department of Chemical Engineering at MIT in 2007. He is a senior editor for Langmuir (ACS journal since 2010), an associate editor for Science Advances (a Science family journal from AAAS since 2018), a fellow of the American Institute of Chemical Engineers (AIChE), a fellow of the American Institute for Medical and Biological Engineering (AIMBE) and a member of Washington Academy of Sciences. He received the Braskem Award for Excellence in Materials Engineering and Science, AIChE (2017). His research focuses on biomaterials, particularly zwitterionic-based functional materials for biomedical and engineering applications.