Molecular Understanding, Design and Development of Ultra Low Fouling Zwitterionic Materials

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Abstract

An important challenge in many applications, ranging from medical devices to ship hulls, 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 using an integrated experimental and simulation approach. Second, we aim to develop biocompatible and environmentally benign ultra low fouling materials based on the molecular principles we have learned. As a result, we have demonstrated that zwitterionic and mixed charge materials and surfaces are highly resistant to nonspecific protein adsorption, cell adhesion and bacteria adhesion/biofilm formation from complex media. Both simulation and experimental results show that the strong hydration of zwitterionic materials is responsible for their excellent nonfouling properties. Recent results show that zwitterionic materials induce no capsule formation upon implantation and no immunological response in blood circulation and are able to maintain protein and cell bioactivities. At present, zwitterionic materials, as alternatives to poly(ethylene glycol) (PEG)-based materials, have been applied to a number of applications, including medical devices, drug delivery carriers, cell media, antimicrobial coatings, and marine coatings.

Biography for Professor Shaoyi Jiang

Professor Jiang received his Ph.D. degree in chemical engineering from Cornell University in 1993 under Profs. Keith Gubbins and John Zollweg. He was a postdoctoral fellow at UC Berkeley between 1993 and 1994 with Prof. Kenneth S. Pitzer and a research fellow at Caltech between 1994 and 1996 with Prof. William A. Goddard, III both in chemistry. He is currently the Boeing-Roundhill Professor of Engineering in the Department of Chemical Engineering at the University of Washington, Seattle. He was a visiting professor in the Department of Chemical Engineering at MIT with Prof. Robert Langer in 2007. He is a senior editor for Langmuir, a fellow of the American Institute of Chemical Engineers (AIChE), and a fellow of the American Institute for Medical and Biological Engineering (AIMBE). He received the Braskem Award for Excellence in Materials Engineering and Science, AIChE (2017). His research focuses on the molecular understanding, design and development of zwitterionic-based functional materials for biomedical and engineering applications.