Bioinspired Zwitterionic Membranes

Design, Development, and Applications

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Abstract

Stable blood compatibility of membranes used in contact with human whole blood is highly desirable for blood-inert devices. The design and development of nonfouling membranes are therefore critically important in biomedical applications, which are highly desirable in the design for human blood-contacting membrane systems. However only a very limited number of synthetic materials are regarded as good hemocompatible candidates. It is suggested via bio-inspiration that a nanoscale homogenous mixture of balanced charge groups from polyzwitterionic materials is the key to controlling ideal nonfouling properties. An important characteristic of a zwitterionic structure is that it should have both a positively and a negatively charged moiety within the same side chain segment while maintaining overall charge neutrality. A set of functional properties is generally used to guide the design of new non-fouling polymer brushes in contact with human blood: they should be hydrophilic and electrically neutral, and hydrogen bond acceptors rather than hydrogen bond donors. For the polyzwitterionic materials, they can be further classified into polybetaines such as 2-methacryloyloxylethyl phosphorylcholine (MPC), sulfobetaine methacrylate (SBMA), and carboxybetaine methacrylate (CBMA). The advantages of nonfouling zwitterionic materials include the simplicity of synthesis, ease of applicability, abundance of raw materials, and availability of functional groups. Our team in R&D Center for Membrane Technology (Taiwan) mainly focuses on the study of bioinspired structure for their fundamental zwitterionic molecular designs as well as the development for potential biomedical applications. This talk will summarize our center's fundamental developments related to the designs of membranes using zwitterionic materials.

Keywords: Bio-inspired, zwitterionic, membranes, nonfouling, blood compatibility