In Vitro Antifouling Assessment of Diethylene Glycol Dimethyl Ether Coating on Silicon Substrates

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Introduction

Silicon nanopore membranes (SNMs) are under investigation for blood filtration in the implantable bioartificial kidney, immunoprotection of β-cells in the bioartificial pancreas, and membrane blood oxygenation applications. The surface of SNMs need to be antifouling and antithrombogenic. Diethylene glycol dimethyl ether (Diglyme) coating has demonstrated excellent antifouling and hemocompatibility properties on plastic tubing. In this study, we examined the protein resistance of thin Diglyme coatings applied to silicon substrates.

Methods

Diglyme coatings (MW: 134.17 g/mol) were deposited on plasma treated 1x1 cm silicon substrates via plasma enhanced chemical vapor deposition (PECVD) technique (Plasmatreat Inc). The coatings were characterized by ellipsometry for coating thickness. Coating performance was evaluated by an ELISA assay to determine the relative adsorption of human serum albumin (HSA) compared to non-coated silicon substrates and tissue culture polystyrene (TCP) as the control.

Results

Ellipsometry data confirm successful deposition of Diglyme coating on the silicon substrates. The coating thickness of the Diglyme coating varied between 5-70 nm as a function of PECVD process parameters, such as power and gas flow-rate (Fig.1. A). There is a significant decrease in HSA adsorption on the 15 nm (2.05%) and 30 nm (2.38%) thin Diglyme coated substrates as compared to the non-coated silicon substrate, which exhibited 35% adsorption relative to the TCP control. Also, significant protein fouling is observed on 5 nm and 70 nm coatings. This data suggests that that 15-30 nm thin Diglyme coatings will exhibit antifouling characteristics. Future studies will focus on coating SNM with 15-30 nm thin Diglyme coatings and examine platelet adhesion and activation of the intrinsic coagulation cascade.

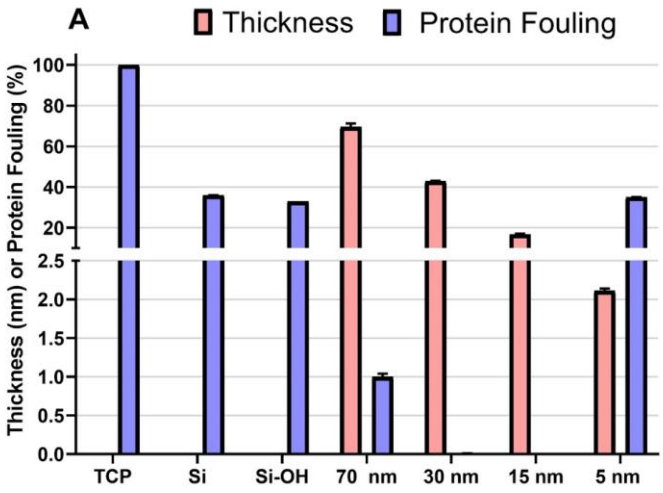

Figure 1. A) Percentage Protein fouling on different thickness of Diglyme deposited on silicon chips and control samples (TCP, bare silicon (Si) and plasma treated silicon (Si-OH)).