Faculty of Engineering and Applied Science
Chemical Engineering Seminar Series

Protein and cell interactions with biomaterials: Surface modification and characterization for improved devices

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Dupuis Hall, Room 215

ABSTRACT

Biomaterials that are used in contact with fluids such as blood are prone to protein adsorption and cell interactions. A protein layer quickly forms at the surface of the material and can influence the subsequent adhesion of cells and microbes. For medical devices such as catheters, stents and vascular grafts this can lead to numerous complications including coagulation, thrombosis (blood clotting) and infection. Chemical and biological strategies to modify the surface of materials can be implemented to better control these interfacial processes and improve device design.

In previous work, both model gold substrates and polyurethane surfaces were modified with polyethylene oxide (PEO), a bioinert polymer known for its ability to resist protein adsorption. PEO was used to attach antithrombin-heparin (ATH), a novel complex with superior anticoagulant function. Surface characterization techniques confirmed modifications and biological methods demonstrated improved anticoagulant activity of ATH. In addition, the initial passive modification steps were applied to microfluidic devices, resulting in reduced protein adsorption and demonstrating potential for future development.

Further investigations using of a range materials are of interest, for applications including blood contacting devices, membranes and biosensors. A combination of strategies that use various bioinert molecules along with an array of active molecules will allow multiple biological processes to be targeted. The ultimate structure and geometry of a particular device is a critical component in studying interfacial interactions. By creating appropriate material prototypes and using advanced characterization methods, links between protein adsorption and other biological interactions can be better understood, ultimately leading to improved devices.