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Anti-thrombotic Coatings for Medical Devices and Implants Based on Nitric Oxide Release

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Abstract

Blood-contacting medical devices, are often used to treat cardiovascular diseases. These implantable medical devices, even if labeled as biocompatible, can cause serious complications in patients. Thrombus formation and infection are the main causes of failure of these devices. In contrast to the healthy endothelium, which actively resists thrombosis, artificial surfaces promote clotting through a complex series of interconnected processes that include protein adsorption, adhesion of platelet, leukocytes and red blood cells, ending with thrombosis.

Using a layer-by-layer thin film building strategy to form layers of polyethyleneimine (PEI) and iNOSoxy as NO-releasing coatings allows for assembly of multi-component protein/PEI films. Here, the iNOSoxy enzyme protein used is negatively charged and adsorbed onto the positively charged matrix layer, polyethyleneimine. When discs coated with PEI/iNOSoxy films are exposed to arginine, a source of reducing equivalent, and other required ingredients, nitric oxide is formed and released. We characterize the PEI/iNOSoxy thin films in terms of structure of iNOSoxy within the films as well as the amount of active concentration. Fourier transform infrared (FTIR) spectroscopic analysis characterized structure-activity relationships of these NOS-containing thin films. Cyclic voltammetry determined the active catalyst (iNOSoxy) concentration on the modified surfaces, and how this relates to enzymatic activity and resulting NO release fluxes from PEI/NOS-containing thin film. Platelet adhesion assays determined if the amount of platelets adsorbed on the PEI/iNOSoxy films is inversely proportional to the amounts of NO released from coatings.

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