Surface Treatment for Blood-Contacting Materials

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Technology description

Application

New technology developed by UGA researchers combines the clot-preventing capabilities of liquid infused porous materials with the antibacterial effects of Nitrous Oxide. This combination can have great impact in many blood-contacting devices, serving as the base material (for applications such as tubing, catheters, stents, vascular grafts, extracorporeal circulation, urinary catheters, etc.) or coatings of other implantable devices. Liquid infused porous surfaces show huge potential due to their ability to greatly reduce bacterial adhesion and clotting in blood-contacting devices. Another method to improve the biocompatibility of these blood-contacting materials is the deployment of Nitric Oxide (NO). NO is a small, naturally produced molecule which the body uses to decrease the activation of platelets as they flow in the blood stream and to kill unwanted bacteria. NO is also released from the sinuses as a preventative measure to reduce the risk of infection. Combining the use of liquid infused materials with the natural antibacterial molecule, NO, creates a synergistic effect that produces the benefits of both methods, while negating the protein clotting effects of NO has individually. The infused liquid will provide a thin barrier between the material and contacting fluids (such as blood), while actively reducing platelet adhesion and activation. The NO in the liquid will also kill any bacteria that have adhered to the surface.

Technology Summary

This technology combines an NO releasing molecule with liquid-infused materials to provide an ultra-low fouling surface while providing active means of reducing platelet activation and adhesion and increasing bactericidal activity. The NO molecule, "SNAP," was incorporated into medical grade silicone rubber tubing through a solvent swelling process. The impregnated tubing was then treated with Silicone Oil (Si – Oil), to provide a liquid-infused final product. Incorporation of the Si – Oil resulted in a number of synergistic effects, such as decreased leaching of the NO, as well as limiting the immediate burst effect typically seen from NO releasing materials. The presence of the Si – Oil, combined with SNAP, drastically reduced fouling of the material. The ability of SNAP-Si oil to decrease adhesion of platelets was proven through extensive testing. While NO alone showed 74% reduction, and Si - Oil alone showed 56% reduction, the combination of NO with Si- Oil showed an 82% reduction when compared to untreated tubing. The SNAP-Si oil combination also resulted in a 99.3% reduction in bacterial growth on the polymer surface over a 7-day study. Overall, this approach allows for the

synergistic effect of active and passive non-fouling approaches to increase the biocompatibility and reduce infection in existing medical polymers.

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