

Scalable Nanostructured Coatings for Prevention of Microbial Biofilm Formation

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This seed proposal focuses on development of antimicrobial nanoparticle-based coatings for medical devices through a scalable, single-step assembly process. We will focus specifically on biofilm formation of *Pseudomonas aeruginosa*, a pathogen implicated in a significant number of hospital-acquired infections (HAI), including the majority of cases of ventilator-acquired pneumonia (VAP) among critically-ill patients. In healthcare settings, surface coatings of small-molecule antibiotics have been found to aid in delaying in biofilm formation, but there are concerns related to long-term resistance to biofilms, regular cleaning of surfaces, and development of antibiotic resistance among pathogens. Thus, there is an unmet need to design new coatings for medical devices that rely on alternative strategies for antimicrobial activity.

We envision nanostructured coatings that provide a physical barrier to biofilm formation. The coating fabrication utilizes a cost-effective evaporative assembly process, providing an advantage in terms of ease of application and manufacturing scalability. The project represents a new collaboration between PI Bhatia, who has extensive expertise in nanomaterials and biomaterials; and co-PI Boon, an international leader in bacterial biofilms. The objective of this seed proposal is to gain sufficient preliminary data to enable a competitive proposal submission to external agencies. Milestones include fabrication of coatings, assessment of biofilm formation through static and colony studies, and long-term characterization of biofilms using flow reactor studies. As described in our strategy for submission to an external sponsor, our two main targets for external funding are NIH and the Engineering Biology and Health programs within the Chemical, Bioengineering, Environmental, and Transport Systems (CBET) division at NSF. As such, we have chosen to focus on antimicrobial surfaces for devices in healthcare settings. However, antimicrobial surfaces have numerous other applications, including paints and coatings for marine vessels, surfaces for food preparation, and antifouling coatings for water treatment facilities. Thus, over the long term we plan to explore additional types of bacteria relevant to these applications, and to seek external funding from sponsors such as the ONR and USDA, as well as other programs within NSF.