ABSTRACT

Surface Plasmon Resonance imaging (SPRi) is a label-free detection method with the capability of real-time detection of multiple interactions occurring simultaneously on a gold surface. In this work, SPRi will be used for the first time to study bacterial adhesion/growth, biofilm formation/disassembly, and cleaning of biofouled surfaces. These processes are important to study because biofilms are reservoirs of bacteria and a source of endotoxins, which both can enter the circulation system of a patient and cause systemic disorders. More than 60% of hospital-acquired infections are caused by bacterial biofilms. Formation of biofilms is the main cause of many bacterial infections.

SPR detection is based on changes in the refractive index at the sensing surface caused by changes in the composition of the material directly above (~200 nm) the sensor surface. Unlike in traditional SPR where a single point on a surface is measured, SPR imaging allows the rapid collection of information about refractive index changes and the location of these events with high precision (~10 μm) over a large area (~1 cm^2) simultaneously.

Using a SPRi system, physiological behavior of bacterial cells and biofilm dynamics will be monitored in real-time. This information will be used to help predict and control bacteria activity in fluidic systems. Studies will be conducted to determine the effectiveness of different chemicals and antibiotics in removing biofilm from a sensor surface. The efficacy of antibiotics and surface coatings for preventing biofilm formation on the surface will also be studied. Finally, the effects of geometry and fluid dynamics on bacterial suface adhesion and removal will be investigated.