Studying bacterial behavior with Surface Plasmon Resonance imaging (SPRi)

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Surface Plasmon Resonance (SPR) based sensors provide highly sensitive, label-free detection with the capability of real-time monitoring of surface phenomena at the molecular level. SPR uses evanescent waves to detect changes in the refractive index adjacent to the sensor surface allowing label-free detection. Any changes to the local refractive index (because of binding on the surface) vary the SP wave vector at the interface between metal and dielectric. These changes subsequently vary the resonance condition between SPs and the interacting optical wave. In SPR detection based on the measured property of the interacting optical wave with SPs, three different modulation methods exist: angular, wavelength and intensity. Surface plasmon resonance imaging (SPRi) works based on a fixed angle and detects the changes in the intensity of the reflected light to gain an image; SPRi has a charge-coupled device (CCD) camera which gathers the reflected light from the entire surface and by using a sensogram measures the reflectivity changes upon adsorption of material to the surface. At the beginning of each SPRi experiment an image is selected as a reference image. Throughout the experiment, a difference image is generated based on the change between the reference image and the current image. This allows us to track over time any changes in reflectivity due to surface binding.

The combination of SPRi and microfluidic systems will improve the evaluation of changes on the surface, whether it is the interaction of analyte with the immobilized biospecific partner on the surface or the growth of biofilm in the channels and on the prism surface.

We are interested in studying bacterial movement and biofilm formation in the microfluidic systems. In this study, biofilm growth of CFP-labeled *Pseudomonas aeruginosa* PA01, *Pseudomonas aeruginosa* PA14 and GFP-labeled *Escherichia coli* (*E.coli*) has been monitored by SPRi.

Using SPRi we also detected growth and movement of GFP-labeled *Escherichia coli* in the channels and on the prism surface. Bacterial cells respond to the gradient of chemicals in their environment is known as chemotaxis. They also interact with each other by chemotactic signaling through the chemoreceptors. It is known that bacteria form biofilm when they aggregate until they reach sufficiently high density; the tendency for congregation is dependent on the geometry of the environment that bacteria grow as well as the gradient of chemical concentration in the environment. For the first time in this study we monitored the bacterial aggregation with SPRi in a simple geomentry as first step.