74e Detection of Bound Analyte in a Local Evanescent Array Coupled (Leac) Biosensor

Matthew D. Stephens, David S. Dandy, Guangwei Yuan, Kevin L. Lear, Jonathan K. Gerding, and Alan Van Orden

The present work focuses on the development of a multianalyte sensor that uses antibodies, DNA, proteins, or aptimers as selective probes. The probe for each analyte is immobilized in a discrete region on the surface of a planar waveguide. The binding of an analyte to a probe region is detected by measuring the change in intensity of the local evanescent field surrounding the waveguide core.

The waveguide core is composed of a thin film of physical vapor deposited silicon nitride, with stoichiometry chosen such that the film refractive index is 1.80. When the waveguide is immersed in water the refractive index above the core is 1.33. Any organic molecules bound to the surface of the waveguide will change the refractive index above the core from 1.33 of the water to 1.45. As a result of this index change, the evanescent tail of the light guided down the waveguide will shift so as to penetrate farther from the waveguide core. The intensity of the evanescent field is determined by scanning the waveguide surface using a near-field scanning optical microscope (NSOM).

To characterize and quantify changes in the evanescent field, simulated biological adlayers are created on the surface of the waveguide, and the evanescent field response is measured in air. As an initial approximation of the adlayer, step changes in the actual waveguide core were fabricated via deposition and etching, and it was found that the evanescent field changed significantly (>40%) over the step changes. To better approximate the actual refractive index change of a biological adlayer, two additional fabrication procedures were used: SiO_2 with a refractive index of 1.45 and Shipley 1818 photoresist were used to fabricate adlayers of known thickness on the waveguide core. In addition, in a third set of experiments the adlayers were created using a PDMS stamping technique to attach polystyrene nanospheres and DNA to the surface of the waveguide core.

The evanescent field response to the adlayers measured by NSOM will be presented, including the effects of adlayer width and height on the evanescent field response. Oscillation and recovery of the evanescent field after a refractive index change will also be discussed. This oscillation phenomenon influences the spacing between adjacent immobilized probe regions. Suggestions for the waveguide geometry that provides the most significant response for a known target analyte size will also be presented.