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Development and Optimization of Surface Plasmon-Polariton Based Sensing System

Techniques based on the Surface Plasmon-Polariton (SPP) phenomenon are a common approach to realizing high-performance refractive index sensors. In our laboratory, we have designed and built such a system which is capable of measuring the refractive index of liquid samples. This is done by injecting a sample liquid into a fluidic system, consisting of a Polydimethylsiloxane (PDMS) walled chamber designed to hold the sample flush to the surface of a gold coated glass slide. This boundary is then illuminated with a laser beam and the excited SPP is observed. The current SPP-based sensor is capable of detecting refractive index changes (Δn) of about 0.0022. Our goal is to increase sensor performance by investigating several improvements to system components. This includes evaluating enhancements to the fluidic system layout to reduce the required sample volume to make a measurement, modifying the optical layout to increase system angular resolution, and improving the quality of the gold film which will improve the sensitivity of the sensor. This includes testing alternate gold adhesion layer compositions, improving the smoothness of the gold surface, or comparing different deposition methods to achieve the highest quality SPP. This investigation documents an improvement in overall system performance by showing an increase in system sensitivity through a decrease in measureable change in refractive index. Measuring this optical property can help determine the identity of a liquid, along with determining solute concentrations. Future investigation involving PDMS microfluidics will facilitate interdisciplinary collaboration, including chemical, biological, and medical applications.