Silica Micro-Tube Resonator-Based Optical Biochemical Sensors

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Biochemical sensors based on optical microresonators can reduce the size of a sensor by orders of magnitude without sacrificing the interaction length and the sensitivity by virtue of the high-Q resonances, thereby significantly reducing the amount of sample needed for the detection. In this project, silica microtube resonators were studied by using the prism-coupled method and act as refractive index sensing and surface sensing elements. Record high sensitivity of \(~600\text{nm/RIU}\) in the resonator-based sensors is observed in the index sensing experiment. The theoretical study shows that this is the result of a new type of resonance mode, which has the highest optical field present in the low-index fluid region, and maximizes the interaction of light with the analyte solution flowing though the micro-tube. The device can achieve a detection limit of refractive index change \(~5 \times 10^{-6}\). In surface sensing experiment, the device can easily detect the binding of a lipid bilayer membrane. Calculation shows that the smallest detection thickness can reach 0.1nm. This project is supported by the U-M Life Science Institute-Thermal Fisher Pilot Grant N007594.