Silica Micro-Tube Resonator-Based Optical Biochemical Sensors

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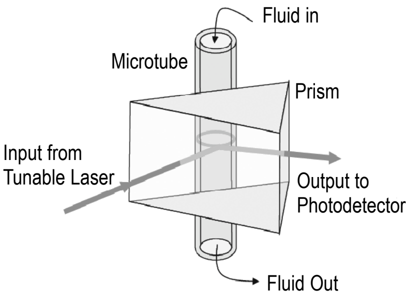
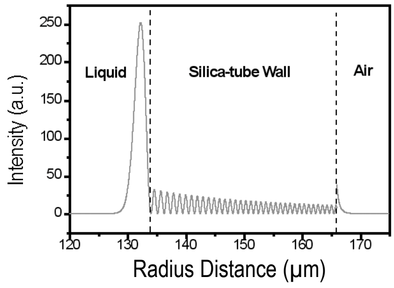
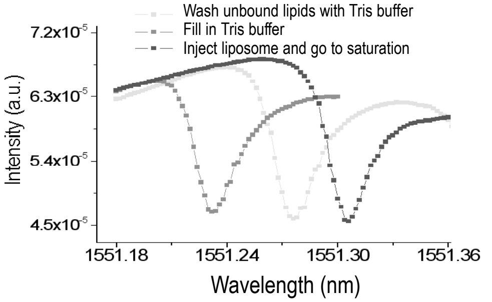


The schematic of experimental setup.



Radial field intensity distribution of the super high sensitivity mode.



Resonance cure shift due to the lipid bilayer absorbed on the inner wall of the tube.

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 micro-tube resonators were studied by using the prism-coupled method and act as refractive index sensing and surface sensing elements. Record high sensitivity of ~600nm/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 ~5×10^{-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.