Supporting Information for

Sensitive Refractive Index Detection Using a Broadband Optical Ring Resonator

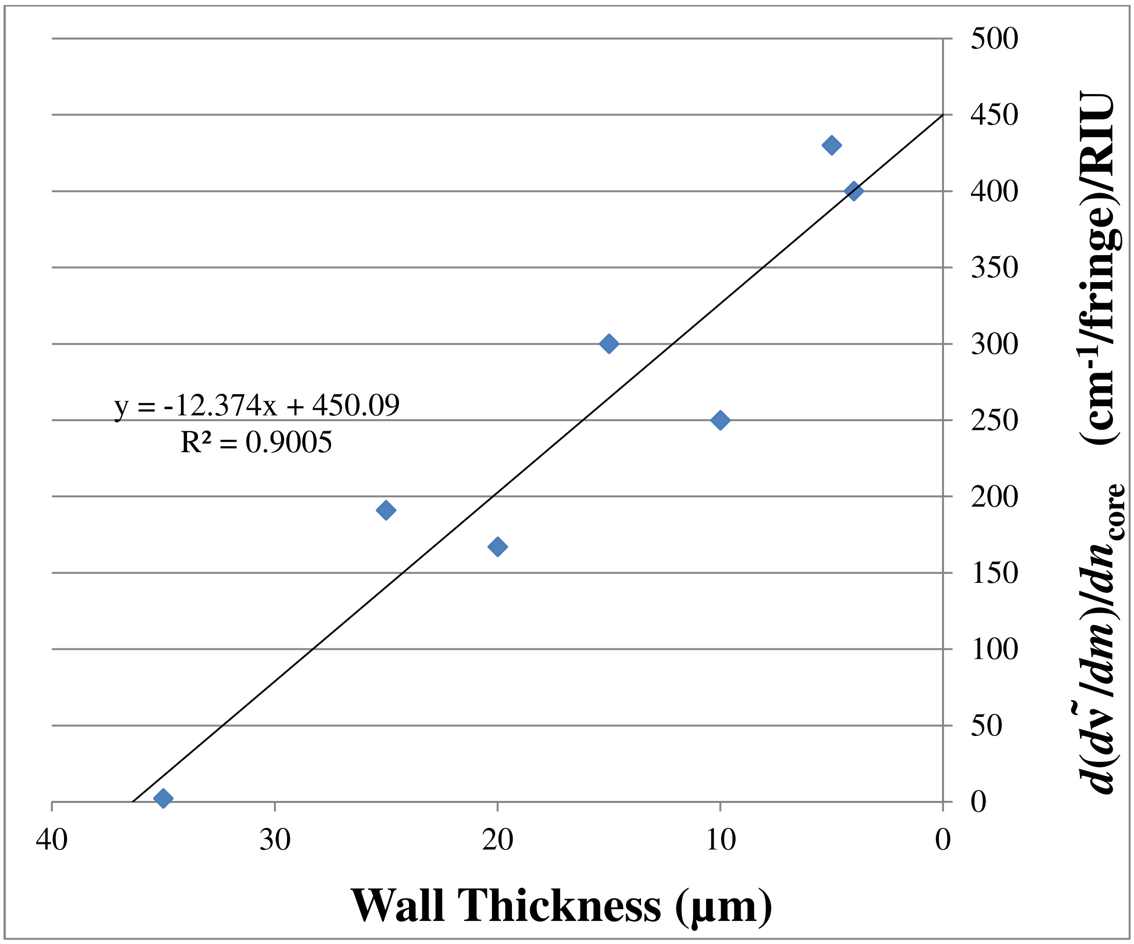

Figure S-1- Refractive index sensitivity is shown as a function of wall thickness. A great deal of variability is shown, likely a function of the discussed modal complexity- which, for a thicker wall should be increased due to the wider range of supported propagating modes. Nonetheless, a general trend shows increasing sensitivity with thinner walls, which is expected as the relative fraction of modes that are interacting with the core is increased.

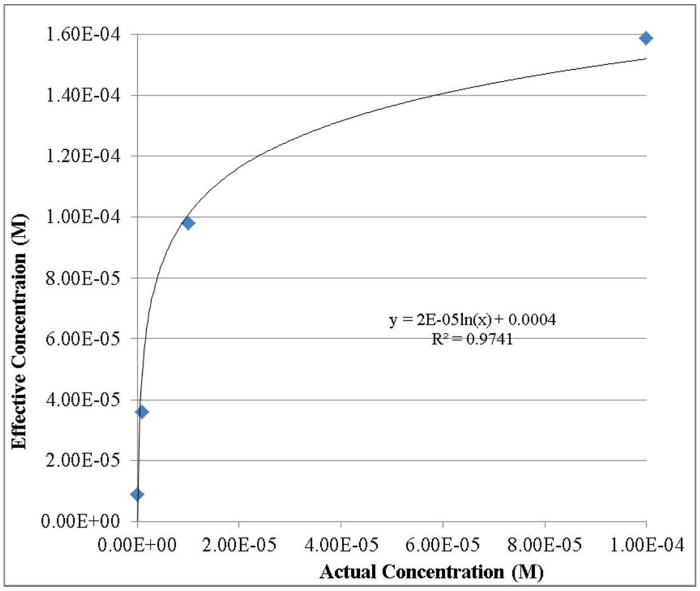

Figure S-2 – Effective surface pre-concentration of methylene blue, a surface-active (attracted) dye, vs. actual introduced sample concentration in the bulk of the capillary.

The shape of the Bovine Serum Albumin binding curve in Fig. 6 agrees with another surface binding experiment, shown in the above Figure S-2. This was collected with absorbance measurements using the same LCORR. The majority of this work is described elsewhere[17] but briefly the enhancement of a surface-attracted cationic dye, methylene blue, was observed in the LCORR by taking and comparing absorbance measurements. An effective pathlength, L_{eff}, was established using a non-surface-attracted dye, bromothymol blue in pH 8 buffer, and later verified again using Sudan black B in ethanol. Derived from Beer's Law, and based on the relative absorbance seen in the LCORR compared with a standard cuvette, the effective pathlength was found to be on the order of 1mm for both of these dyes. This pathlength represents the total sum of evanescent field penetration into the sample, largely less than 1µm, at each reflection point. As the resonating field strength is very near the surface, surface active analytes such as the methylene blue, shown in the figure, can be detected with great sensitivity. In the figure, effective surface concentration is derived from Beer's law to represent the concentration of analyte that would be required to produce the measured absorbance in a bulk measurement with a pathlength equal to the L_{eff} (1mm here).

The logarithmic shape of the Effective vs. Actual concentration plot for methylene blue actually lends itself very well to the expected biomolecule surface adsorption kinetics. At very low bulk solution concentrations, the surface concentration of methylene blue increases dramatically with the wide availability of surface sites to bind to. As the bulk solution concentration increases, the available binding sites fill up and the difference between surface and bulk concentration is diminished. This kinetic behavior agrees well with previous literature regarding surface binding and detection of biomolecules

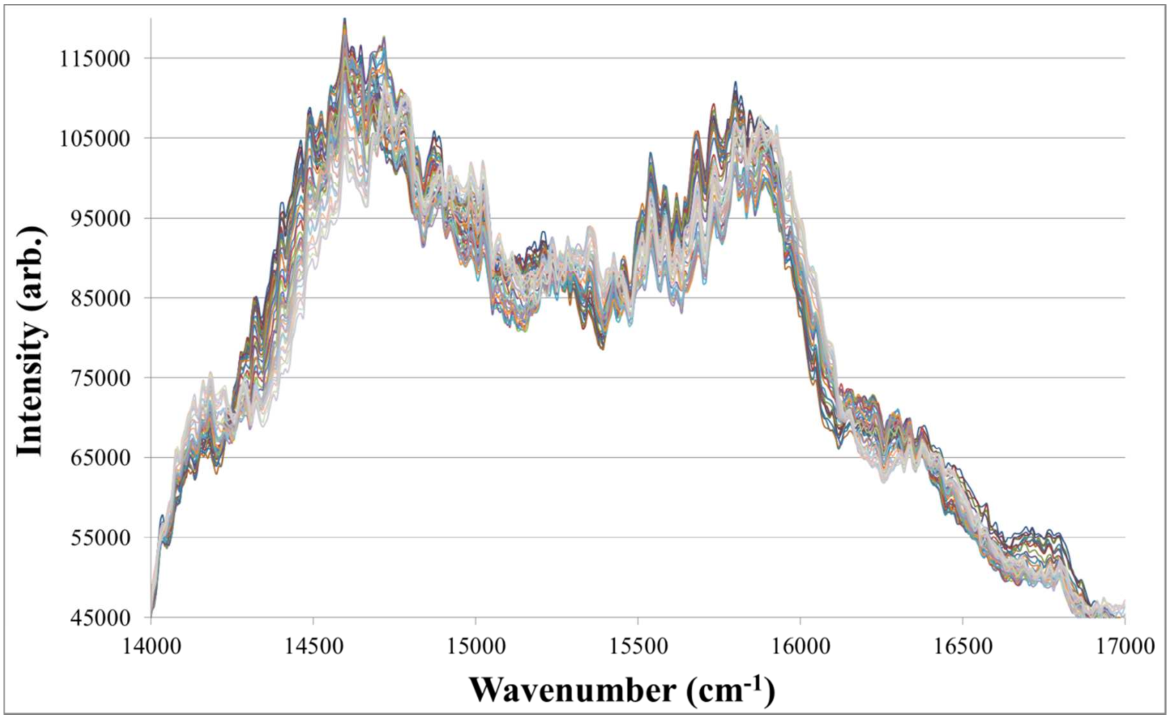

Figure S-3- Low resolution output spectra (150g/mm grating) from LCORR for 40 incremental mixtures of IPA/Water with RI ranging from 1.3605-1.3680 in steps of approximately $2x10^{-4}$ RIU.

To estimate the noise contribution from temperature fluctuation, two additional experiments were performed. A T-junction with a micro-thermocouple was installed on the capillary, just downstream of the ring resonator region. In the first experiment, a sample of deionized water was slowly heated. Over 30 minutes and a range of 0.8K (at the thermocouple), interference spectra were collected, per Figure 3(a). From the corresponding FT spectra, a representative peak was tracked over this range. Shown in figure S-4, this peak position is shown as a function of temperature.

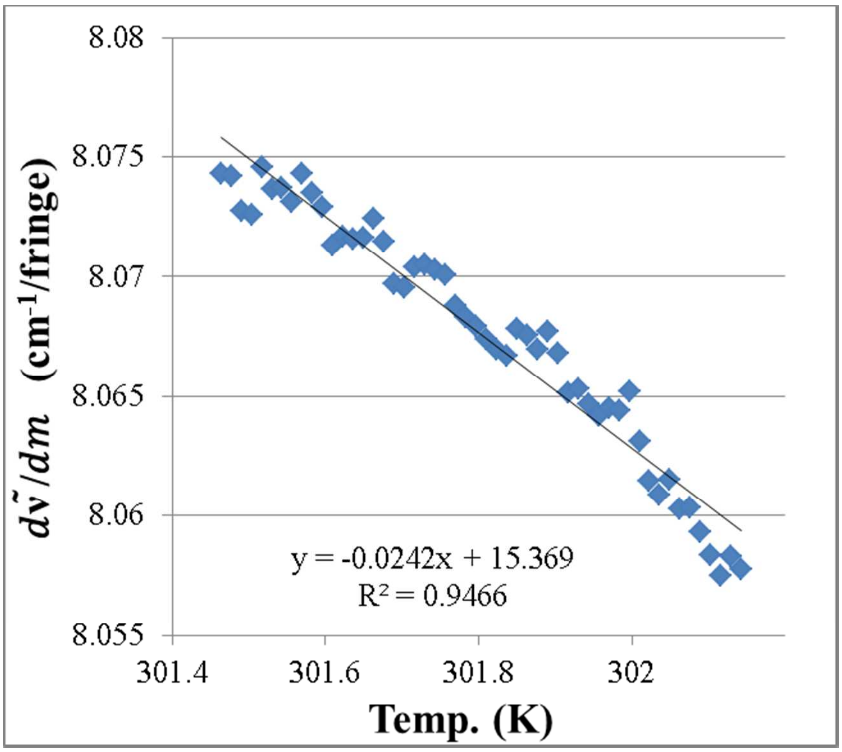

Figure S-4- FT peak position as a function of temperature.

In second experiment, the sample solution temperature was left at room temperature (as all other previous experiments have been performed) and the thermocouple output was taken for 30 minutes. The noise (standard deviation of the temperature) was found to be 3.3 x 10-3 K. From the relationship presented in Figure S-4, the temperature-induced noise corresponds to 8.0 x 10^{-5} cm^{-1}/fringe. As the total noise was earlier shown to be 3.86 x 10^{-4} cm^{-1}/fringe, the temperature-induced noise is estimated to contribute approximately 20% of the total noise.