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Project Title: Enhancing the Limit of Detection of a Biconically Tapered Fiber Optic Sensor

Synopsis: We propose that including a fiber-optic sensor as a component in a laser loop will enhance the sensor’s limit of detection.

Abstract: Biconically tapered fiber-optic sensors (BTFS) have great potential to be powerful and cost efficient tools for detecting analytes, such as antigens, proteins, and DNA. Fabricated to assume a biconical shape, fiber tapers act as interferometers in which mode coupling in the thin waist region of the taper produces an interference spectrum. Each BTFS has an inherent limit of detection (LOD), upon which wavelength shifts due to changes in refractive index (RI) are indistinguishable from noise in the system. We hypothesize that using a single, much narrower laser peak to measure peak wavelength shift over time will result in a better LOD than using a wide peak associated with broadband light. This is because it is far easier to determine the center of a thin peak and, therefore, changes in wavelength can be more accurately determined. Including the taper as part of a laser loop, we find that lasing happens at one of the peak wavelengths present in this spectrum and the rest of the peaks are suppressed, resulting in a spectrum that is dominated by a single peak. First, we confirmed by experimentation that our lasing mechanism is stable to 0.2 pm, minimally. This means that we should be able to use our laser loop, with a BTFS included, to detect shifts in wavelength due to RI change to at least this much. Our next steps are to test our system’s ability to do just that by collecting data when our taper is submerged in various solutions of ethanol.