The field in the normal direction is evanescent and represents non-radiative nature of surface plasmon polaritons (SPP). Just above the metal in the specimen, the decay length of the evanescent field of SPP, is approximately half the wavelength of the light involved. As the resonance conditions approaches the evanescent field height increases which marks the existence of SPR in the vicinity of dielectric and metal interface. Figure 2 shows the evanescent field of sensor. Evanescent field is well inside that sensing medium, which confirms the viability of the sensing.

This device works based on normalized reflectance spectra of light. The light reflected from the back of the di-electric grating is normalized with the input light. At a certain wavelength when SPR was generated in the metal-dielectric interface, eventually a sharp dip was observed in the reflectance spectra. The Full-Width Half-Maximum (FWHM) of this minimum is very narrow (~5nm). The narrower FWHM, the better overall figure of merit of the sensor.

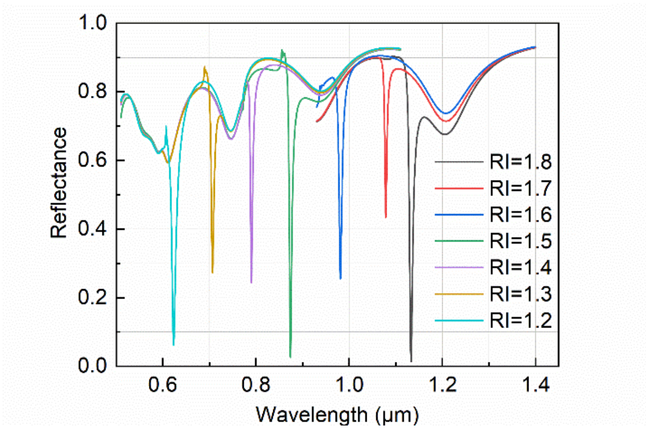

Figure 3: Reflectance spectra when different refractive index is being sensed.

When materials having different RI was sensed this sharp fall was observed at different wavelengths. This is the basic scheme of sensing. From figure 3 it is observed that as RI of speciman increase, the sharp fall of reflectance spectra occurs at higher wavelengths. Each collapse of spectra is well apart from each other (almost 1000nm). This can be explained from the following dispersion equation of Surface Plasmon [7], $k=\frac{\omega}{c}\sqrt{\frac{\varepsilon_m\varepsilon_d}{\varepsilon_m+\varepsilon_d}}$, where ε_m and ε_d are the permittivity of metal and surrounding dielectric medium, respectively. As ε_d is related to the RI also changes eventually altering the wavevector k. When ε_m and ε_d are equal and opposite of each other wavevector is maximum which indicates resonance. ε_m depends on the wavelength of incident light and ε_d depends on the refractive index of the dielectric analyte environment which on the top of the metal film.

To find the sensitivity of the device a minimum point of the reflection spectra vs wavelength graph was plotted. Figure 4 displays the sensitivity graph. The sensitivity was found to be linear. Linearity can be determined by coefficient of determination, R^2. The equation is more linear if R^2 value is closer to 1. It was determined by the following equation.

$$R = \frac{n(\sum xy)-(\sum x)(\sum y)}{\sqrt{[(n\sum x^2)-(\sum x)^2][(n\sum y^2)-(\sum y)^2]}}$$

For this simulated device R^2 was 0.997. The slope of this line defines the sensitivity of the total system.

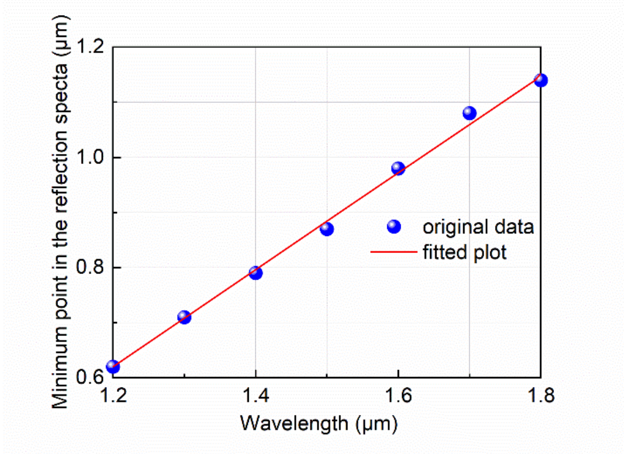

Figure 4: Sensitivity of the biosensor.

The figure of merit (FOM) is another important criterion that determines performance and viability of any sensor. For plasmonic biosensors FOM is defined as sensitivity divided by the resonance linewidth (FWHM) [8]. For this device FOM was 888.89/5≈178.

In conclusion a real time, label free biosensor design is proposed and numerically investigated on a transparent bendable PDMS substrate. The biosensor could detect a wide range of biomolecules having refractive index from 1 to 1.8. The sensitivity of the biosensor was almost 900nm/RIU. The sensitivity graph was linear all throughout the sensing range. The FOM of the sensor was also up to mark.

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