# Biosensing with high Q-factor dielectric metasurfaces

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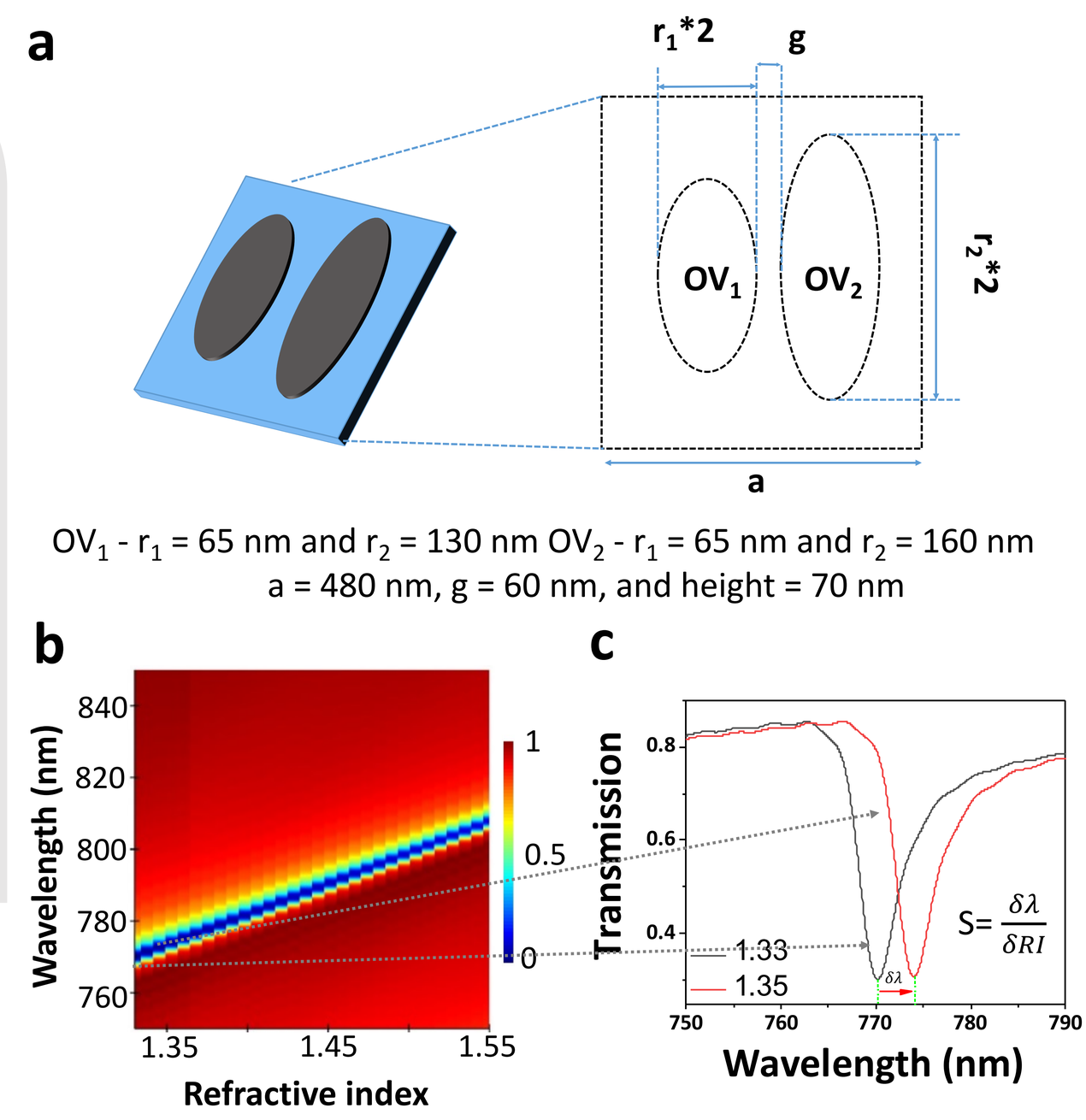
## ❖ Abstract

Currently, optical sensors for diabetes and multiple sclerosis are bulky lab-based devices with low sensitivity and requires labelling of biomarkers. As a result, health diagnosis is very expensive, and not readily available. In this work, we employ, dielectric nanoresonators to obtain high sensitivity which are non-invasive, label-free, and can be easily integrated into point-of-care devices.

## ❖ Introduction

- Metasurfaces are an array of subwavelength resonating particles that strongly interacts with the immediate surroundings[1-4].
- The resonance frequency of metasurfaces changes with respect to refractive index (RI) of the surroundings, hence acts as a refractive index sensor[2-4].
- The sensitivity (S) depends on Quality-factor (Q-factor) and losses in the material. $Q \approx \frac{resonance\ frequency}{resonance\ width}$
- In this work, we employ high Q-factor dielectric resonators to obtain high sensitivity (see figure 1).
- By employing RI sensing method one can detect small quantities of biomolecules around the metasurface.




$OV_1$ - $r_1$ = 65 nm and $r_2$ = 130 nm $OV_2$ - $r_1$ = 65 nm and $r_2$ = 160 nm
a = 480 nm, g = 60 nm, and height = 70 nm

Figure- 1 a) Schematics of a single unit cell of the metasurface. b) Numerically simulated 2D plot of transmission spectra vs refractive index change. c) 1D plot of transmission spectra

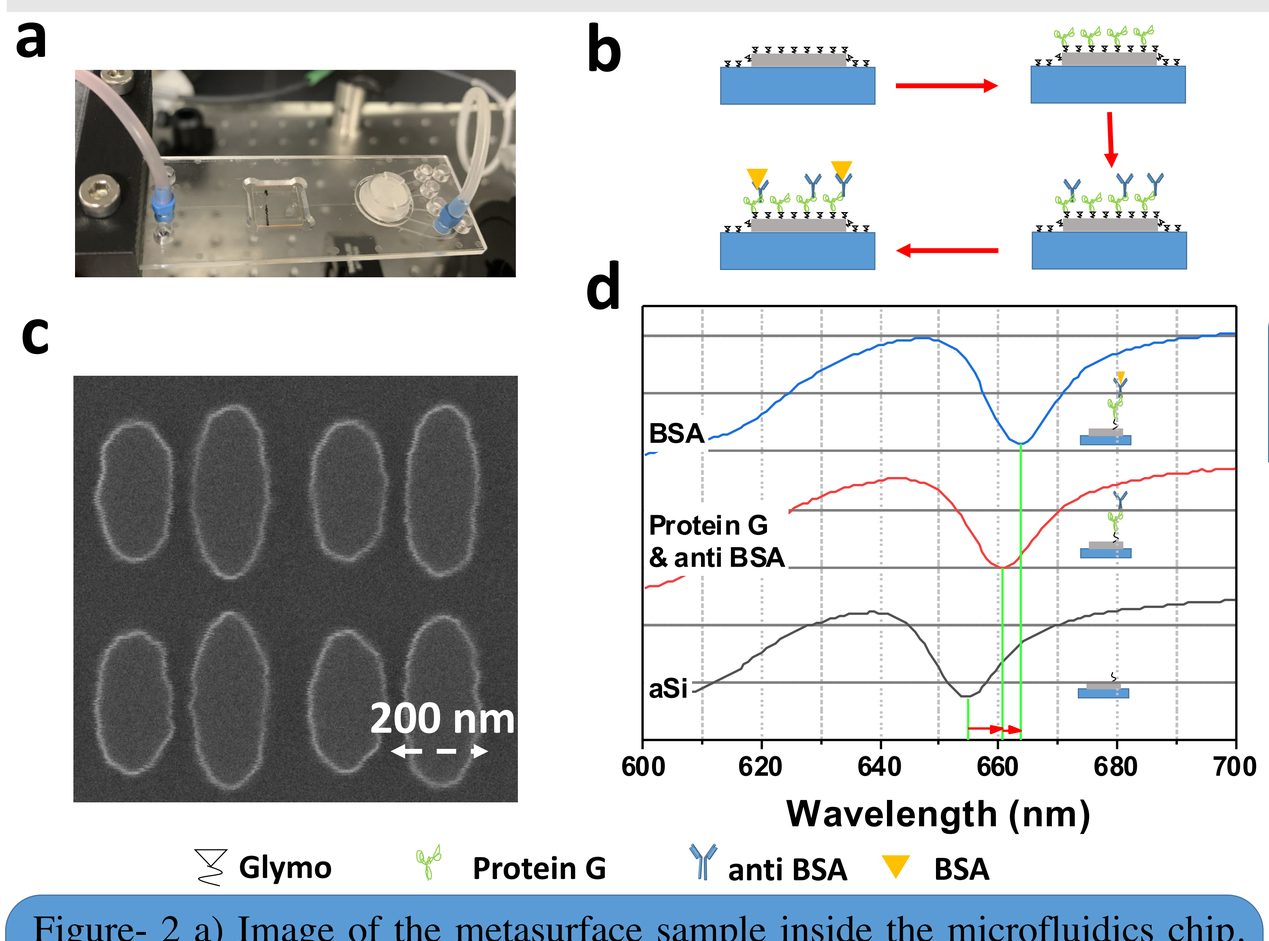



Figure- 2 a) Image of the metasurface sample inside the microfluidics chip. b) Schematics of the functionalization process of the metasurface. c) SEM image of the fabricated sample. d) Experimental transmission spectra after attaching each biomolecule.

## ❖ Results

- We immobilised bioreceptors on to our metasurface using silane surface chemistry (As shown in the figure 2a).
- The bioreceptor (protein G- Antibody BSA) combination is used to capture small quantities of BSA (analyte of interest).
- As demonstrated in figure 2b, we can observe characteristic shifts in the resonance dips.

## ❖ Conclusion

In this work, we demonstrated a proof of concept to detect low levels of biomolecules using metasurfaces. This process can be extended to a comprehensive range of biomarkers (antibodies, antigens, proteins, glycans, etc. ) by using appropriate surface anchors to selectively retain them.

## ❖ References

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