

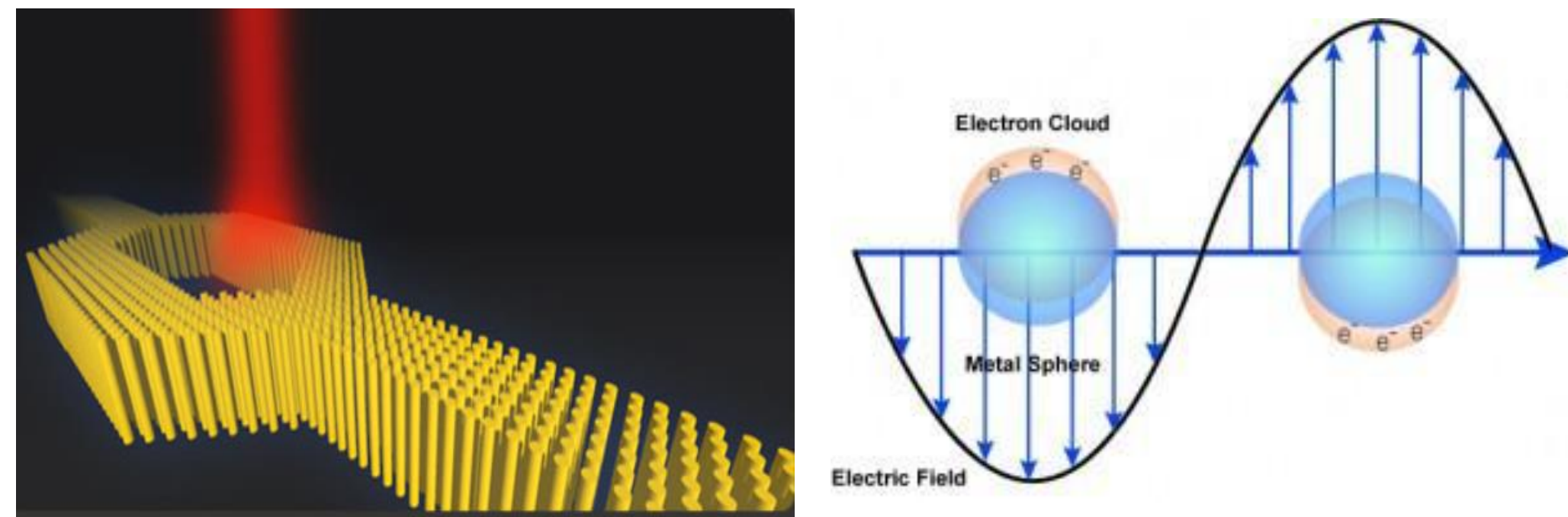
Ultra-High LSPR Sensitivity of Far Field Coupled Gold Nanodisks Array with Undercutting

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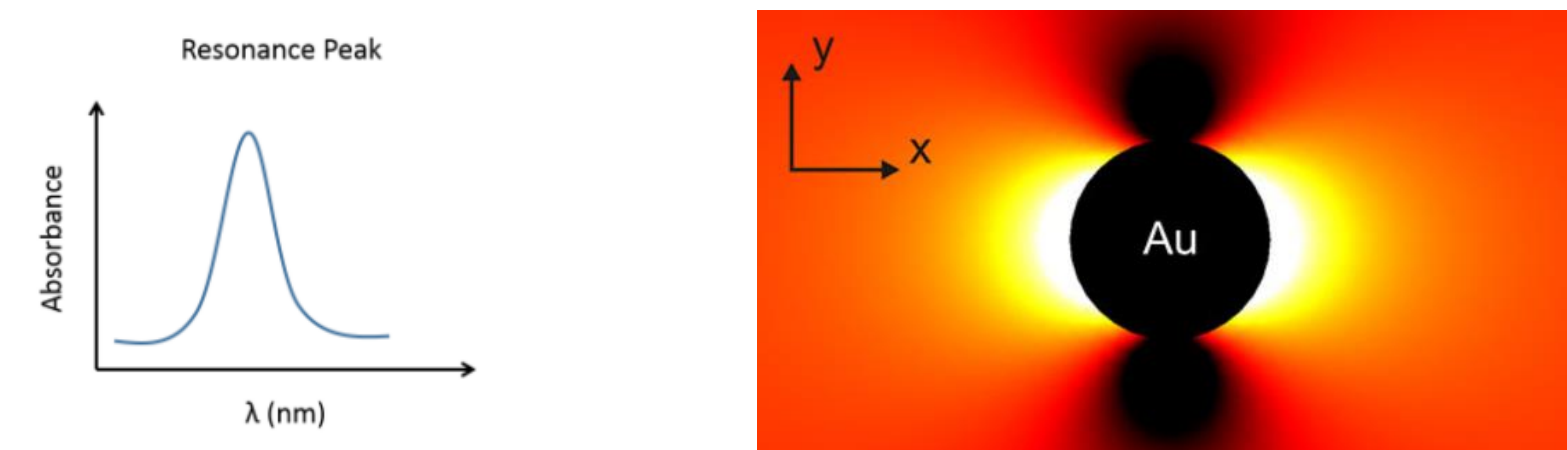
Introducing Plasmonics

- Plasmonics is the study of the interaction of light with the free electrons on the metals.



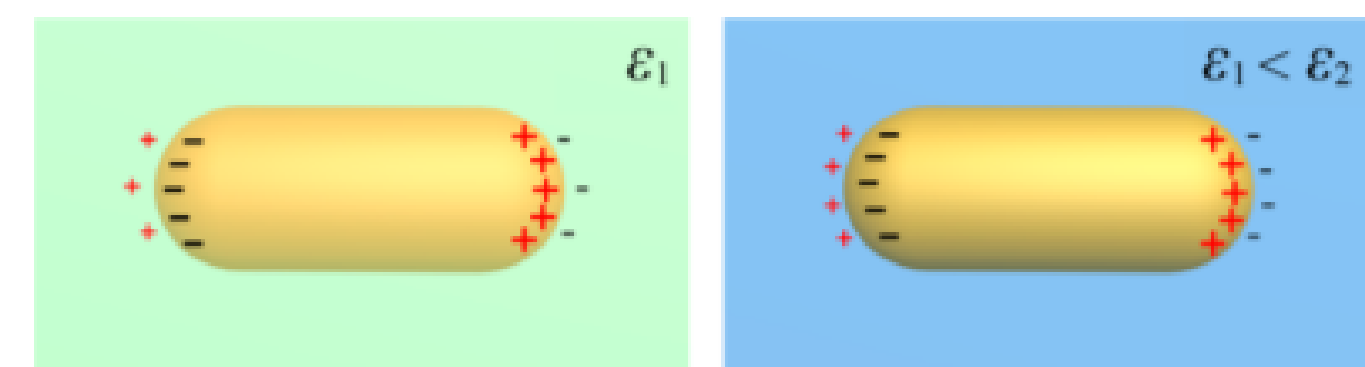
Two Kinds of Plasmonics: Propagating Plasmonics and Localized Plasmonics

LSPR has two distinct Properties!!!
Resonance Peak & E-field Localization



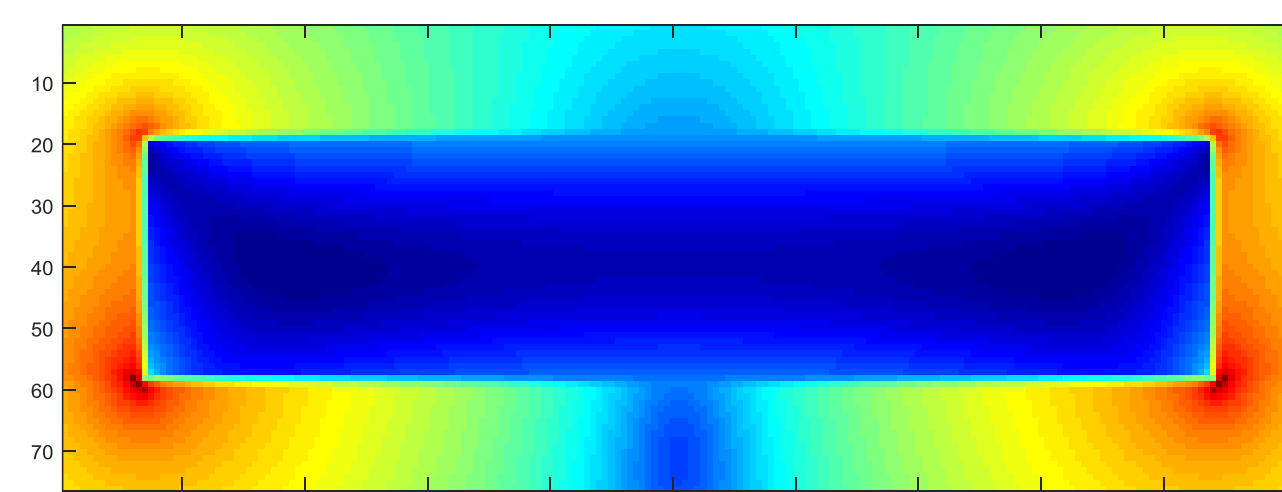
LSPR Sensitivity & Applications

- Highly sensitive to surrounding medium
- Biological Window of Visible to NIR region for Gold and Silver Nanoparticles.

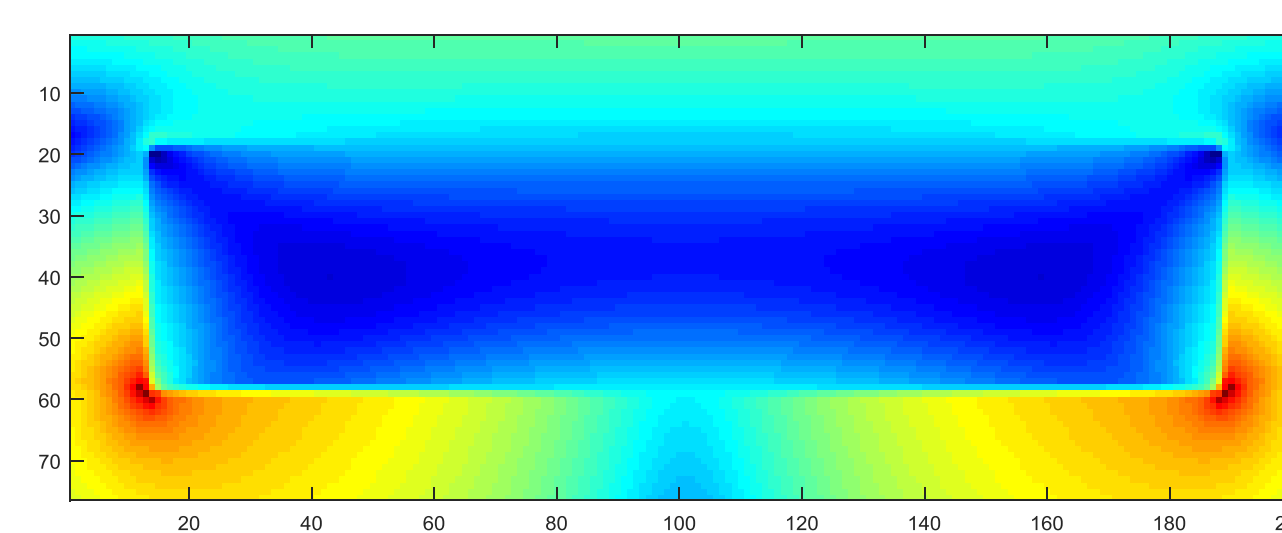


Undercut Gold Nanodisks Array-Why?

Gold Disks in an Array shows significantly Big Array Dependence. This effect is called Far-field plasmonic coupling which leads to blue shifting of the LSPR peak.



Single Disk

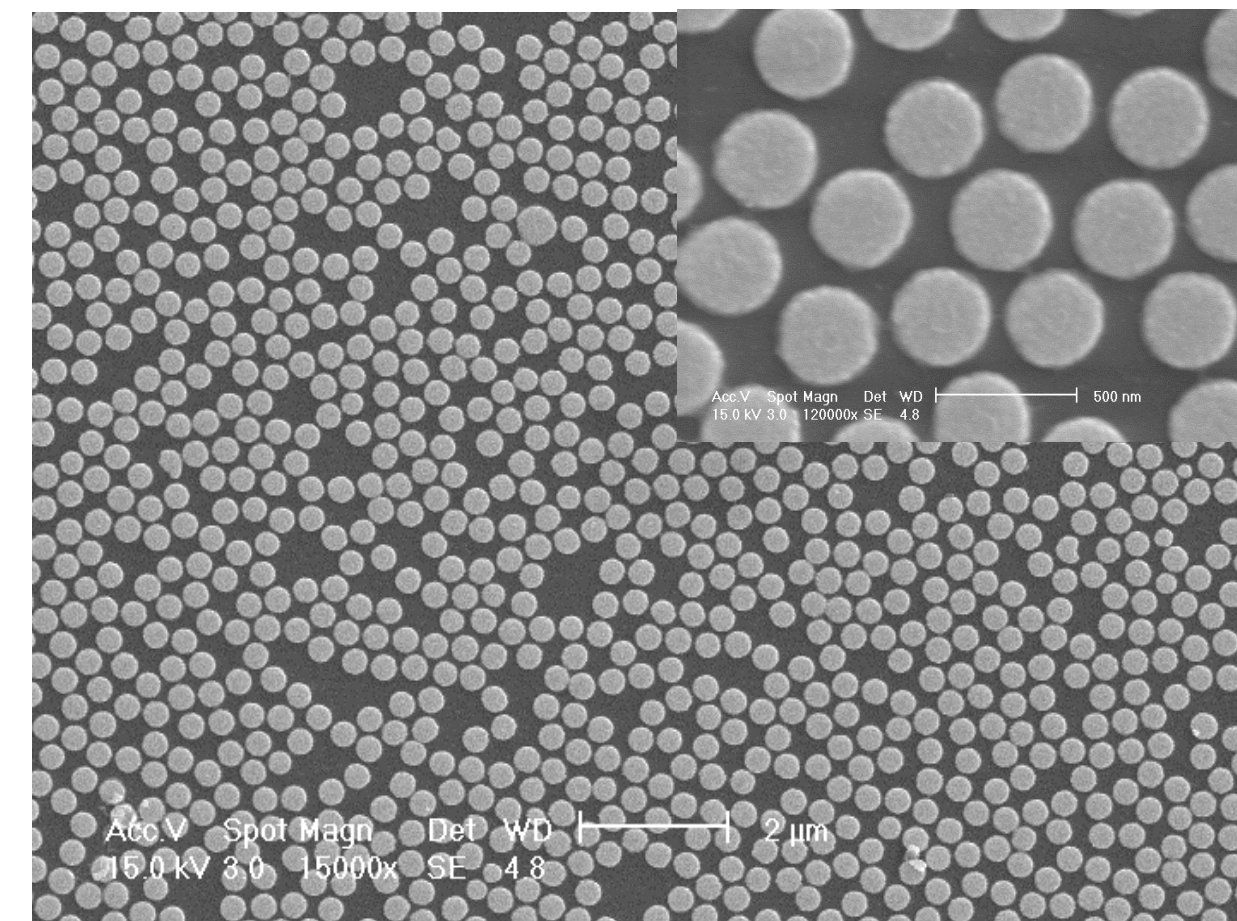


Nanodisk in a Periodic Array

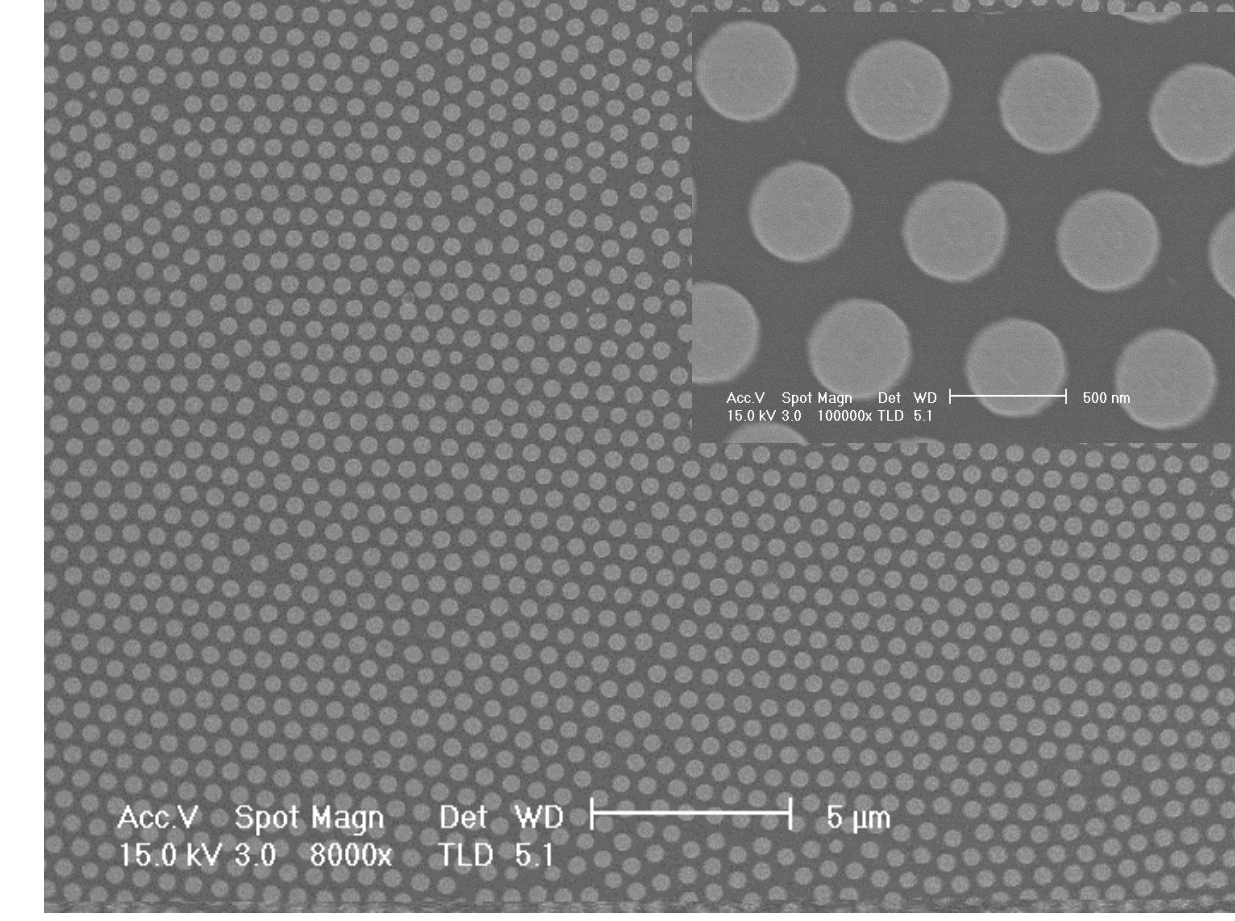
- FDTD Simulation shows significant amount of E-field is pressed towards the substrate because of the array.

Nanosphere Lithography and Undercutting

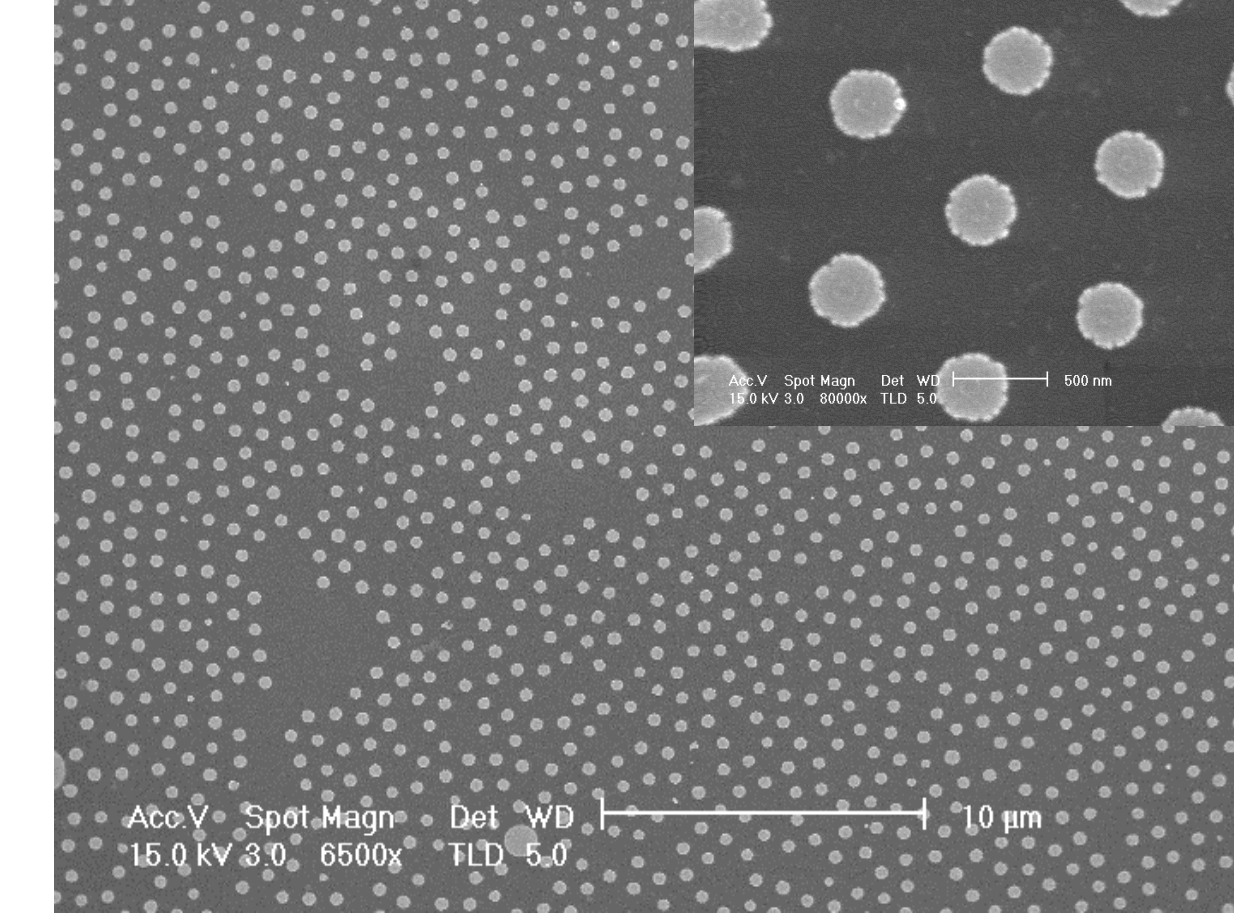
Nanosphere Lithography is an inexpensive technique to produce single layer hexagonally packed structure. NSL is used to pattern Gold films with adhesion layer into nanodisks on a glass substrate. After, the formation of Gold Disks, they were dissolved into HF to produce the Undercutting removing the substrate underneath.



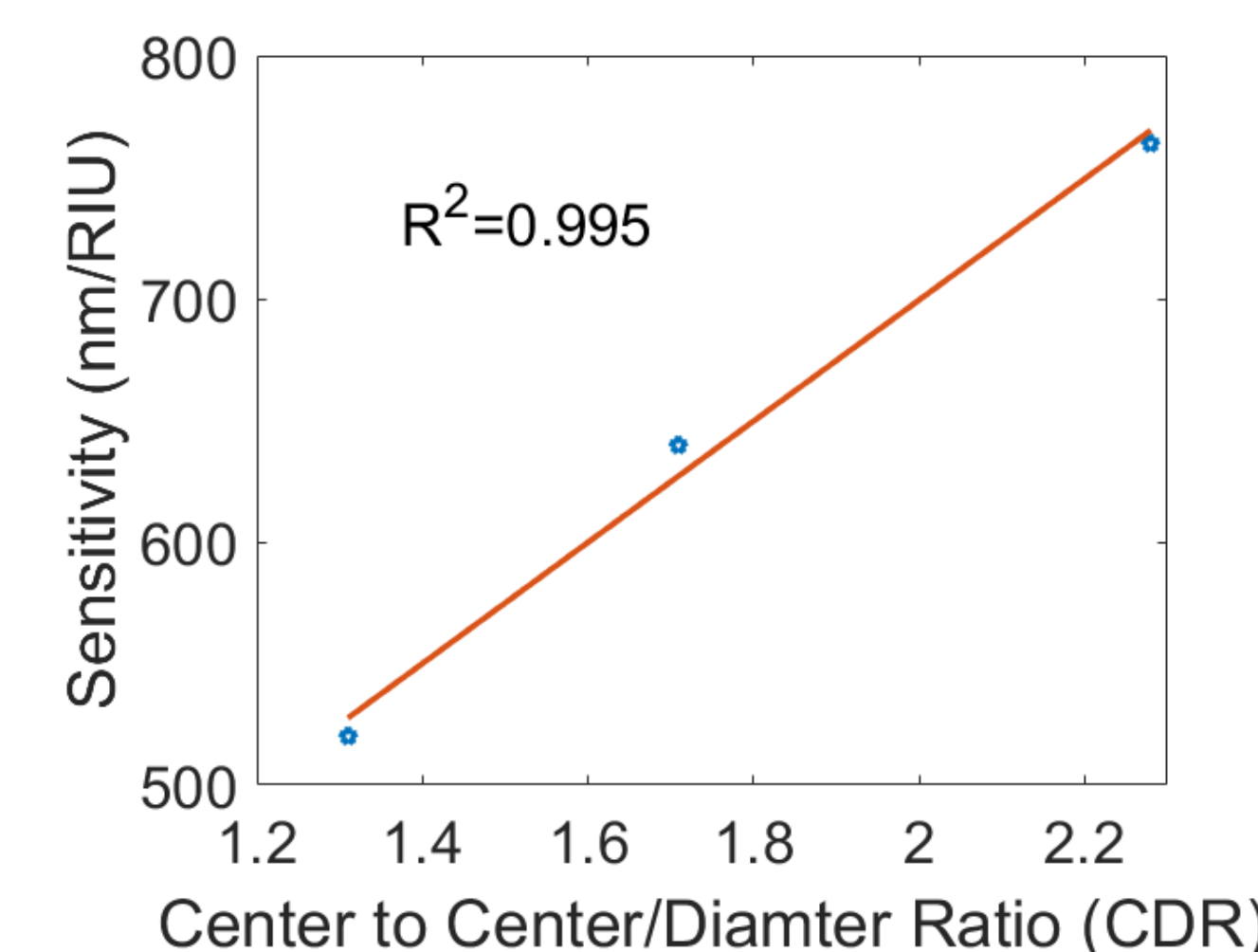
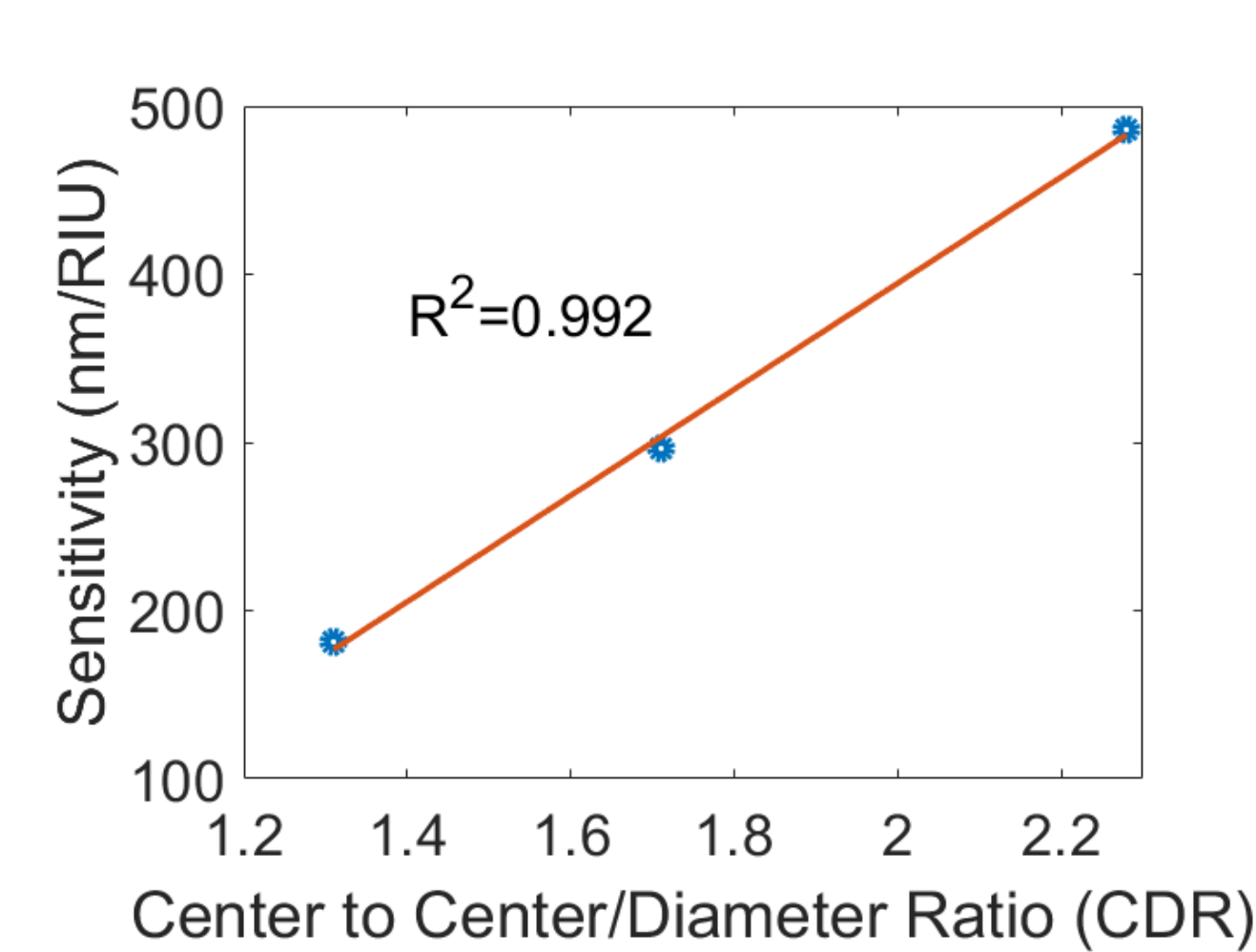
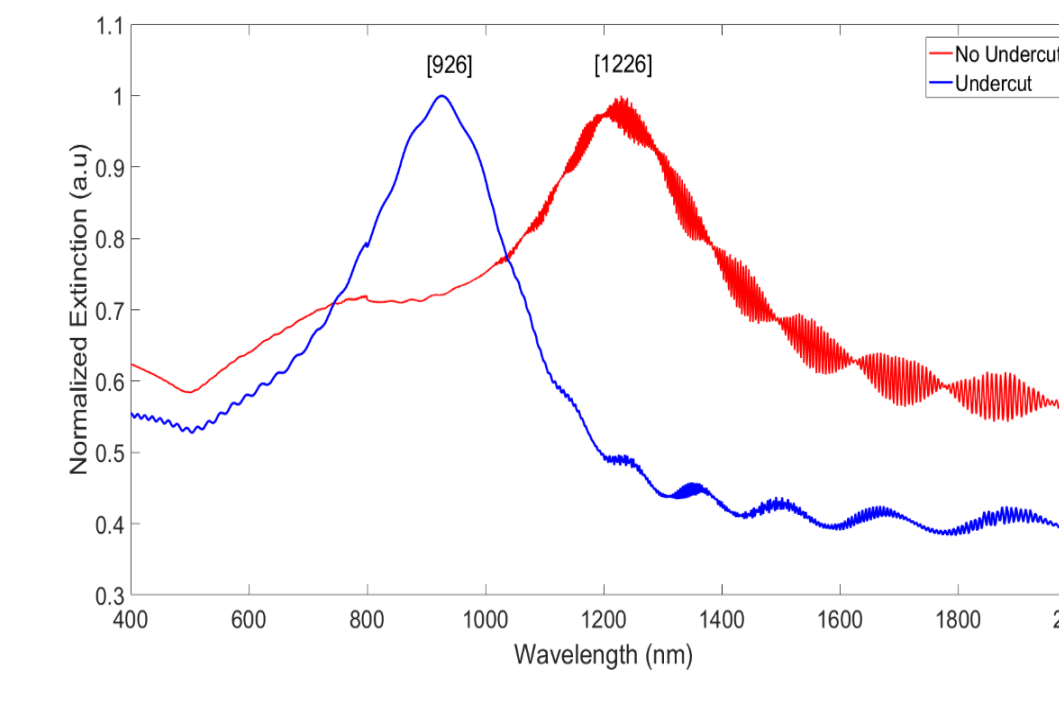
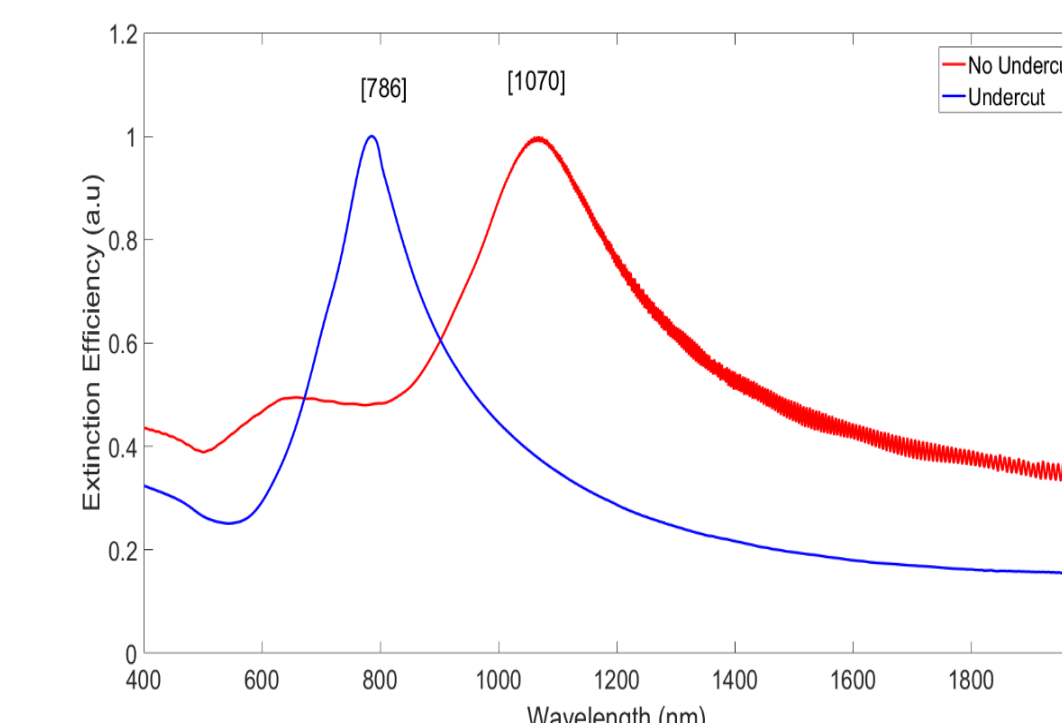
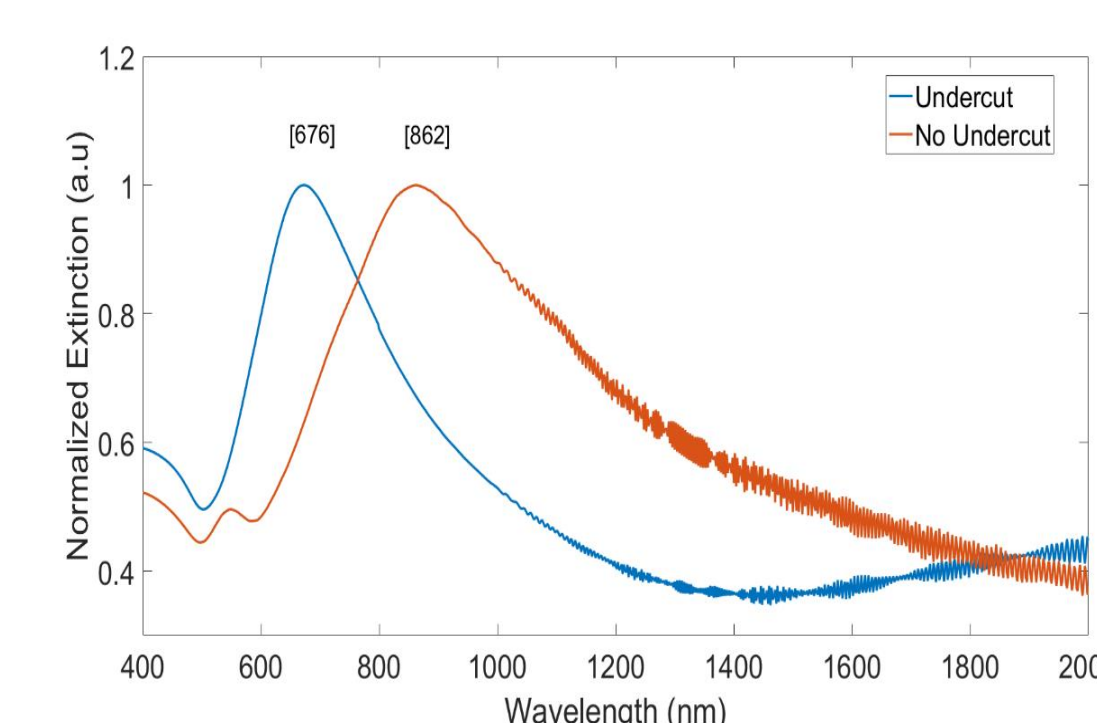
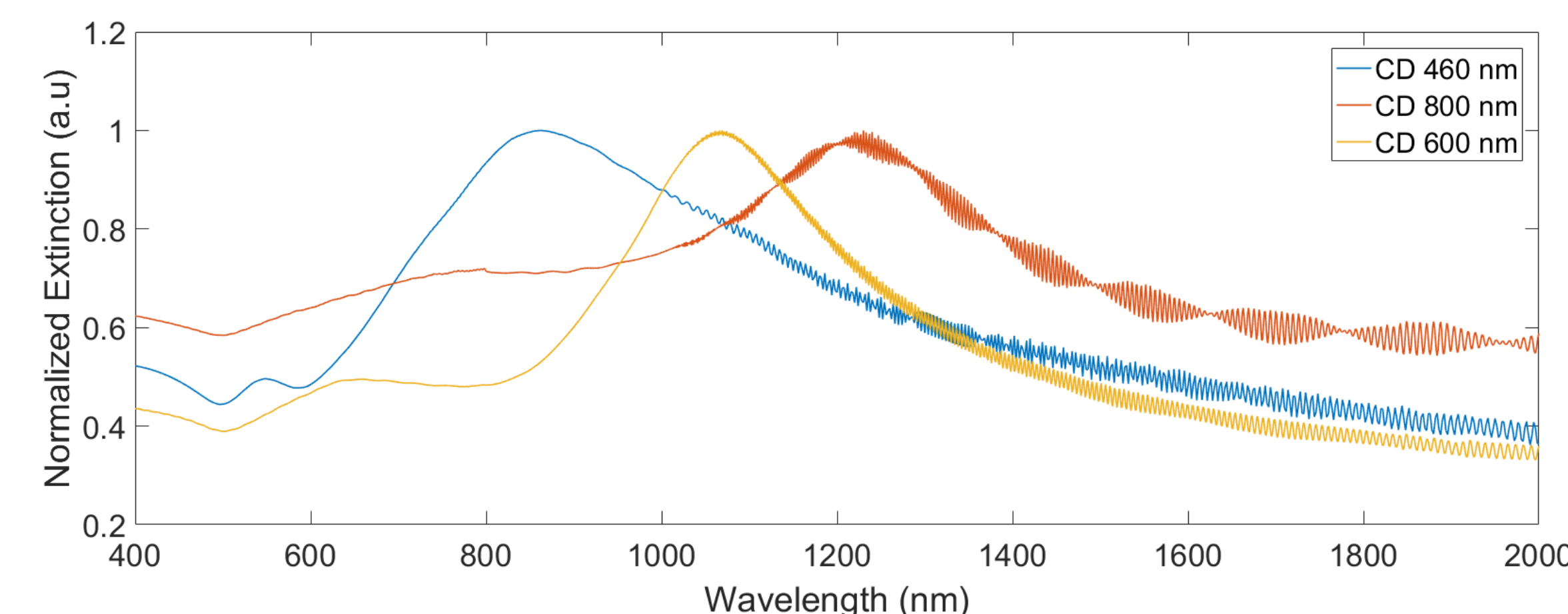
350 nm Disks with period 460 nm



350 nm Disks with period 600 nm

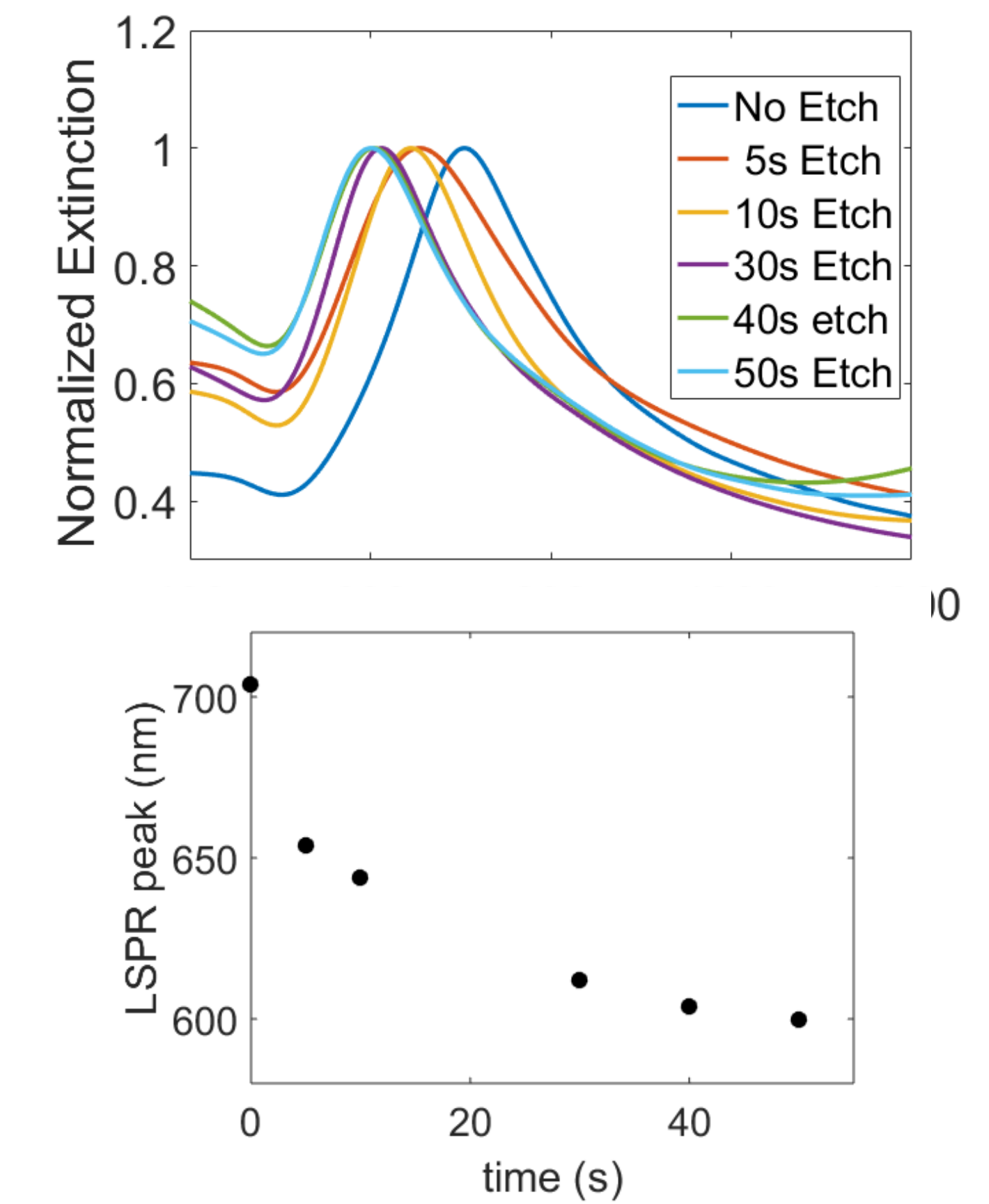


350 nm Disks with period 800 nm



Center to Center Distance	Figure of Merit
460	0.3497
600	0.753
800	0.88
460 etched	1.209
600 etched	1.569
800 etched	2.36

Tuning the Plasmonics



Conclusions

- The Sensitivity increases because of the red shifting caused by FFPC.
- Undercutting the glass substrates below the disks, causes blue shift of peaks.
- However, this blue shifting comes with a major increase in the sensitivity. And, it almost behaves like no substrate has been attached to it.
- The blue shifting of the undercut substrates can be easily tuned with respect to the undercutting time.
- Within the visible range, thus undercutting can be controlled by observing the color changes.
- These highly sensitive substrates can be used for various kinds of biological sensing, photo-thermal reactions.

References

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- Jiang, N., Zhuo, X. and Wang, J. (2017). Active Plasmonics: Principles, Structures, and Applications. *Chemical Reviews*.
- Zhao, F., Arnob, M., Zenasni, O., Li, J. and Shih, W. (2017). Far-field plasmonic coupling in 2-dimensional polycrystalline plasmonic arrays enables wide tunability with low-cost nanofabrication. *Nanoscale Horiz.*, 2(5), pp.267-276.