Characterization of Coupled Gold Nanoparticles in a Sparsely Populated Square Lattice

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Background/Relevance

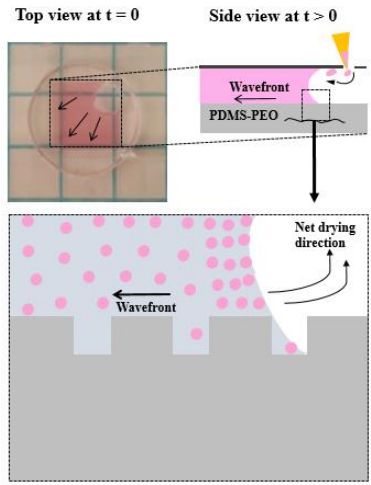
- Ordered arrays of nanoparticles have been shown to increase optical sensitivity in both Plasmon Resonances and Lattice Resonances, but the effects of coupling from sparse arrays has not yet been studied.
- By adding the block copolymer PDMS-b-PEO to a PDMS base and curing agent it has been shown in literature that the water contact angle can be reduced five fold.
- Self-assembly techniques by dewetting have shown to order gold into cavities in silicon substrates, and polymer substrates.

Innovation

- The block copolymer is a cheaper solution than the common hydrophilic treatments of PDMS.

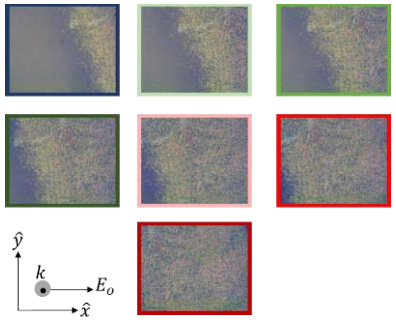
Approach

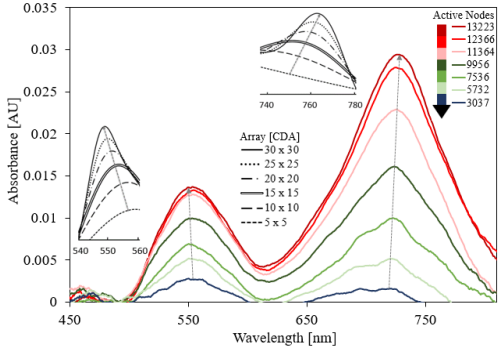
- Polydimethylsiloxane (PDMS) base was combined with a hydrophilic block copolymer to make hydrophilic PDMS-PEO stamps with cavities.
- PDMS-PEO stamps were fabricated using a silicon master stamp.
- Aqueous gold solution was introduced to PDMS-PEO substrate resulting in a sparse 2D array of gold nanoparticles.
- Spectra was obtained in episcopic and diascopic mode in areas with differing amounts of sparsity.



Key Results

- Red-shift of couple lattice resonance (720 nm peak) and blue-shift of plasmon resonance (555 nm peak) are indicative of a coupling between optically active nodes of particles in the sparse array.





Conclusions

- PEO block copolymer's hydrophilic nature helped deposition of gold nanoparticles in a sparse array.
- Statistical analysis of number of optically active nodes in the array shows that couple lattice resonances are measureable with as few as five optically active nodes of particles on average.

Future Work

- Develop numerical technique to determine how empty nodes effect the array coupling.
- Explore thermal effects due to the sparse array.