Plasmonic nanostructured materials by bottom up self assembly of colloids

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Bottom up self assembly processes to fabricate large scale ordered templates made of colloidal particles are viable alternatives to the costly top down approaches that are more commonly used in lithography. One simple way is to spread a suspension of polystyrene beads onto a water surface and pack them into a closed packed structure by tuning the surface tension of water with a surfactant [1]. The structural parameters of the template can be simply adjusted by choosing particles of the appropriate size and subsequently treating the templates under different conditions [2]. Electrodeposition can then be used to deposit metals into the monolayer colloidal templates that were prepared on conductive substrates [3], [4]. Here, we present an entire bottom up fabrication route that makes use of the self assembly of colloids and electrodeposition of metals to develop plasmonic materials with tunable properties.

We demonstrate the relative ease of preparing a single monolayer of closed packed colloids on a substrate and the tunability of the pore size via a controlled sintering process. Furthermore, a plasma etching process can also be used to create non closed packed colloidal templates. By depositing the colloidal templates on conductive substrates, we show that the template prepared by self assembly can be readily used for electrodeposition of different metals to create (1) 2D arrays of gold nanoantennas with tunable geometries and (2) macroporous gold surfaces that exhibit omnidirectional total light absorption properties.

Figures

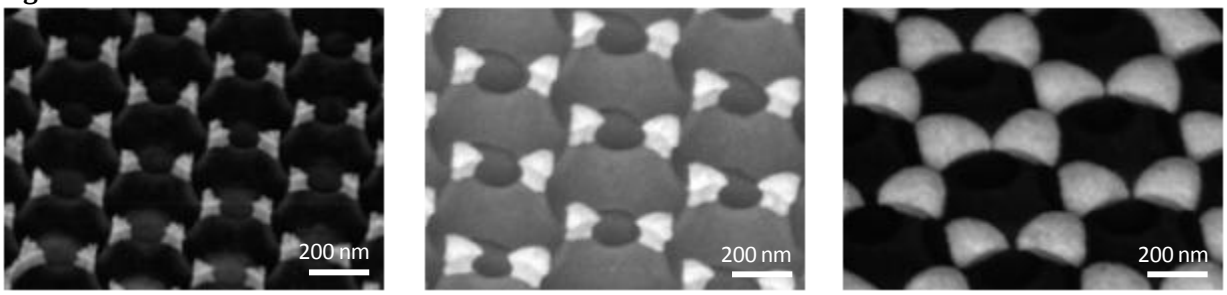

Figure 1. SEM pictures of gold nanoantenna arrays with different geometries.

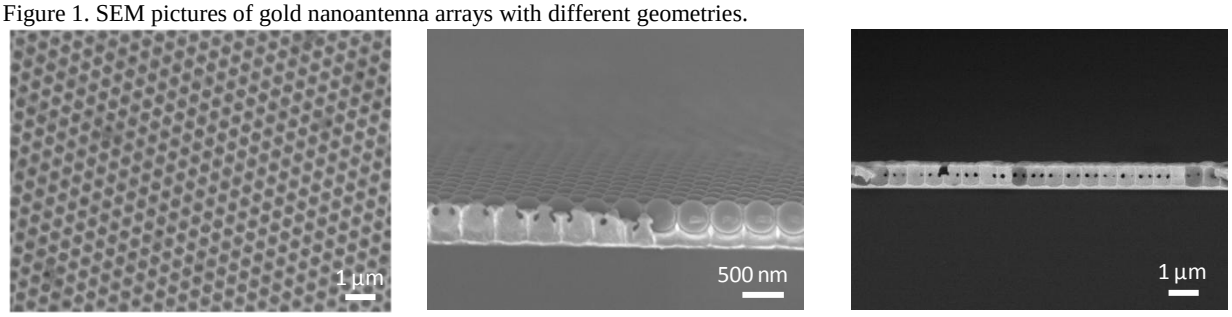

Figure 2. SEM pictures of a macroporous gold surface

References

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Research Axis: Emerging photonics and materials