# Large-scale formation of three-dimensional plasmonic nanodishes using nanoimprint lithography

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There are increasing demands for the development of a reliable and straightforward method to fabricate plasmonic nanostructures which allow us to localize light and to utilize it for various purposes such as localized surface plasmon based bio-chemical sensor. Here, the authors present a wafer-scale formation of three-dimensional gold nanodishes using nanoimprint lithography and oblique-angle-deposition.

In the nanofabrication process proposed, the gold nanodishes were prepared by thermal evaporation of gold on the array of pre-patterned polymer pores consisting of nanoimprint resist and sacrificial under-layer. Since the sample was loaded at an oblique angle with respect to the evaporation source and rotated during the deposition, the surface of both the bottom and sidewall of the polymer pore were covered by the gold layer. Thus, three-dimensional gold nanodishes with uniform sizes and shapes were formed on Si substrate as shown in Figure 1(a). After preparing the gold nanodishes, moreover, the inside of the dishes can be used to contain desired nanomaterials. Figure 1(b) shows that colloidal gold nanoparticles are assembled inside the gold nanodishes. Confocal Raman measurements and electromagnetic simulations demonstrate that the gold nanodishes serve to generate more reliable Raman sensor as well as to improve its sensitivity.

Considering the present results, we expect the proposed nanofabrication process and the three-dimensional nanodishes to be useful for building hierarchical plasmonic nanostructures and hybridizing their functionalities.

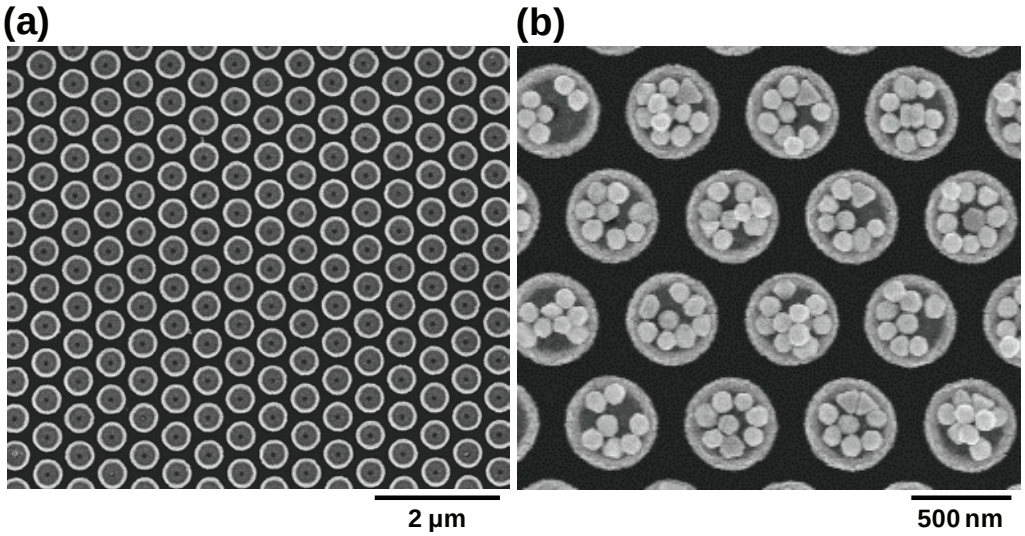


*Figure 1:* Plan-view SEM images of (a) hexagonally arrayed gold nanodishes and (b) gold nanodishes containing gold nanoparticles.