# Plasmonic and optical properties of periodic silver nanoprism array fabricated by $H_2O_2$-assisted nanosphere lithography

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## 1. Introduction

Nanosphere lithography (NSL) method for fabricating the large-scale periodic nanostructure has been widely reported for plasmonics applications [1]. Compared to e-beam lithography, NSL is an inexpensive, reproducible and facile method to produce an order pattern with a large area. However, the drawback of NSL is that predisposition to defect formation limits perfect periodicity down to micrometer-sized area. Thus possible use of NSL for the fabrication of defect-free structures in large domains represents a challenge.

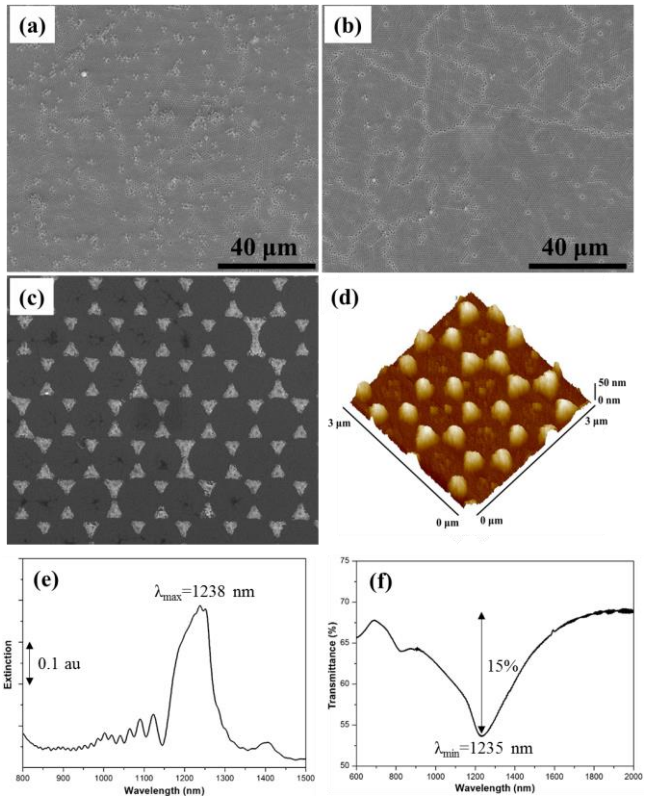
The drop-casting method is a typical technique to fabricate the nanosphere mask. The mechanisms and parameters for the formation of close-packed nanosphere array in perfection were reported, including capillary forces, convective transport of the nanospheres and surface modification. Moreover, the orderliness and quality of the nanosphere array are considerably influenced by the rate of solvent evaporation [2]. In our work, a new method of hydrogen peroxide solution-assisted NSL for fabricating the nanosphere array was discussed.

## 2. Results and discussion

Figure (a) and (b) show the close-packed monolayer polystyrene nanosphere with diameters of 1000 nm fabricated by drop-casting method with and without $H_2O_2$-assistance, respectively. From the large-scale SEM image, it reveals that the polystyrene nanosphere array fabricated without $H_2O_2$-assistance exhibited numerous defects of second layer aggregation. Conversely, through $H_2O_2$-assisted NSL, defectless in large-scale region could be achieved because of the proper density and viscosity of the solution.

The as-obtained nanosphere array fabricated with $H_2O_2$ assistance was used as a mask to deposit the periodic Ag nanoprism array by e-beam evaporation, and the AFM and SEM image are shown in Figure (c) and (d), respectively. The side-length of nanoprism is about 300 nm, and the gap size between two nanoprisms is about 180 nm.

Lumerical FDTD Solutions was used to perform the simulation of extinction spectra of the as-deposited periodic Ag nanoprism array as showing in Figure (e), and exhibits $\lambda_{max}$ value at 1238 nm. The transmittance spectrum of periodic Ag nanoprism array on glass substrate was measured by UV-Vis-NIR spectroscopy as shown in Figure (f), and it reveals that the main resonance wavelength is around 1238 nm, which agrees with the simulated result.




## 3. Conclusions

The defectless nanosphere array with large domain was fabricated by $H_2O_2$-assisted NSL and it was used as a mask for periodic Ag nanoprism deposition. The measured transmittance variation of the periodic Ag nanoprism is about 15%, and the resonance wavelength is about 1238 nm corresponding to the simulated result.

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## References

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