Study of nanospheres lithography technology with super-lens for fabricating nano holes

Shuhong li *, Jinglei du, Yidong hou , Zhiyou zhang , Ruiying shi, Fuhua gao，Yixiao zhang
School of Physics, Sichuan University, Chengdu, 610064, China
e-mail: lsh2772@yahoo.com.cn

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Abstract Text:

The extraordinary optical properties of nano metallic holes have some important potential applications in photonsieve[1], color filter[2] and biosensing[3] etc. Recent years, a few of new technologies have been developed to fabricate the nano holes. In reference[4], we proposed an effective nano holes fabrication method based on super-lens imaging of silver slab. Fig. 1 shows the schematic of our method. The method have many advantages including high efficiency, simplicity, economy and ease for large area fabrication etc.

In order to understand the mechanism of the lithography technology and improve the experiment results, we have detailly studied on the effect of several important factors by calculating and analyzing the energy distribution and frequency spectrum of incident lights passing through the PS and Ag film, as shown in Fig. 2. The Ag film thickness and PS diameter both have important effects on the imaging quality and resolution. Therefore, for different PS sphere, we give the corresponding optimal thickness of Ag film and the highest lithography resolution. The result is shown in Fig. 3. Specially, the optimized Ag film thickness is 26 nm for PS sphere of 600 nm diameter. We are performed the experiment under the optimization condition and nano holes with dimension of 75nm were obtained, as shown in Fig. 4. The feature size of the holes is 18nm larger than the theoretical result. The disagreement is from errors of the Ag film thickness, exposure dose and the developing time.

References:

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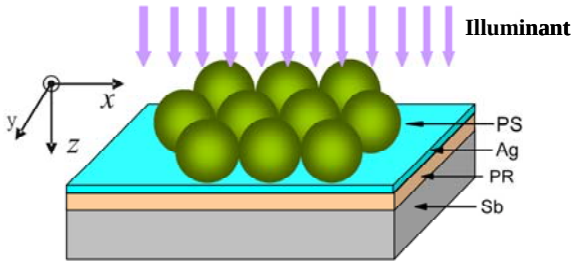

Figure 1. Scheme configuration of lithography with PSs self-assembled on silver slab.

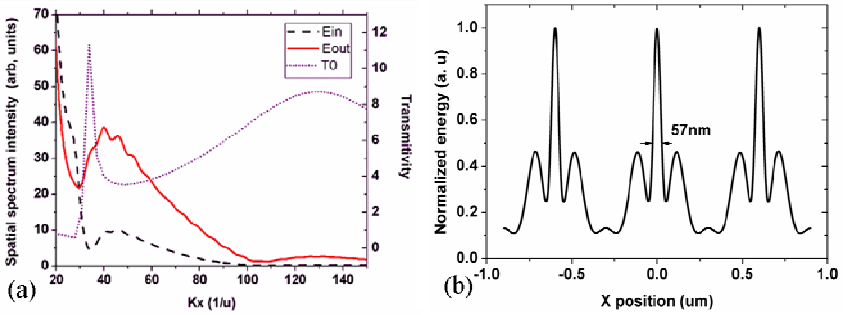

Figure 2. Calculated results (a) Frequency spectrum of incident lights passing through the PS and Ag film (b) Energy distribution on the surface of resist.

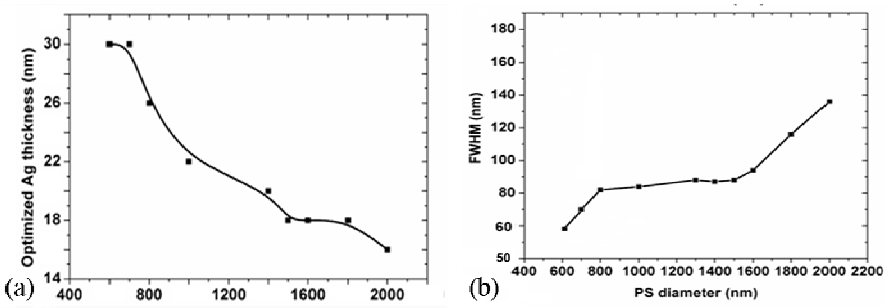

Figure 3. The optimization parameters (a) Relation between the diameter of the PS and the optimal Ag thickness.(b) lithography resolution for different PS at the optimal Ag film thickness

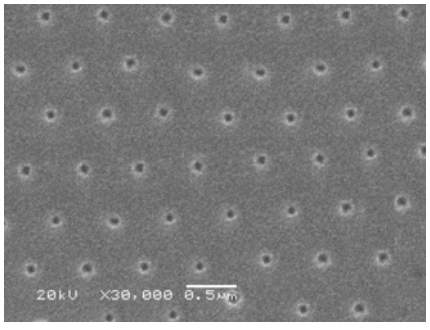

Figure 5. Experimental result with holes feature size of 75 nm