Fabrication of Plasmonic Nano-Pore Array for Nanobio Sensor

Kyung Jin Park,
Team for Measurements and Analysis, National Nanofabrication Center, Science Rd, Yusong Gu, Daejourn, 305 -806 Korea, pkj8890@nnfc.re.kr

Seong Soo Choi,
Research center for NanoBio Science, SunMoon University, Ahsan, Chungnam, 336-708 Korea, sscphy@paran.com

Myoung Jin Park,
Department of Physics, Korea Military Academy, Seoul, Korea

Nam Kyoo Park,
School of Electrical Engineering, Seoul National University,Seoul, 151-Korea,

DaiSik Kim
School of Physics and Astronomy, Seoul National University,Seoul, 151-Korea,

Recently, the plasmonic nanosize aperture array has drawn huge interests for biomolecule translocation and its optical characterization such as surface enhanced Raman spectroscopy (SERS)[1]. In order to fabricate the plasmonic Au nano-aperture array, the patterns with (10-20) micron size were fabricated using photolithography, followed by TMAH wet etching, stress dependent thermal oxidations, and wet backside etching to open the oxide pyramid (Figure 1). The oxide aperture with its diameter of ~200 nm is formed after etching the oxide with buffered 50:1 HF solution. The 100 nm Au thin film was sputter-deposited to form the nano-aperture with ~ 100 nm. For DNA translocation, the width of aperture should be order of few nanometer. In order to obtain the aperture diameter of ~10 nm, 20 keV energy electron beam is exposed. Figure 2 presents the reduced aperture diameter of (12 x 14) nm in (b) from (105 x 80) nm diameter in (a). The aperture with its diameter less than 10 nm is also fabricated and currently under investigation using TEM. Furthermore, with decreasing the size, the electric field enhancement with 10^6 fold from the Au nano-size aperture is also reported[2].. Therefore, the fabricated plasmonic Au nanosize aperture array with its diameter less than 10 nm can be utilized as nano-bio sensor.

References:

[1] Daniel Branton and et al, Nat. Biotechnol. 26,1146 (2008).
[2] F. J. Garcı´a-Vidal and J. B. Pendry, Phys. Rev. Lett. 77, 1163 (1996).

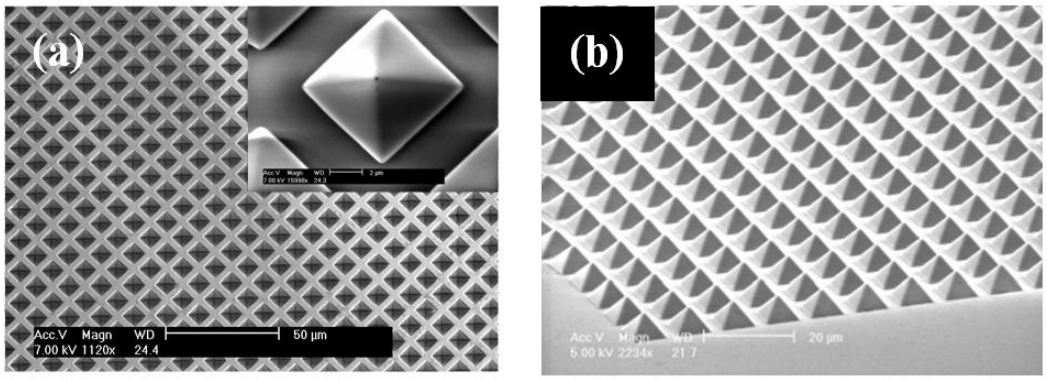

Figure 1: Microfabrictaed Oxide Pyramid Array for Nano Bio Sensor application. The oxide pyramidal array was fabricated using conventional Si microfabrication technologies. The (25x25) pyramidal array is fabricated followed by 50:1 BHF etching to open the aperture at the apex of the pyramid. The top view of the array in (a) and the tilted view of the array in (a) are shown.

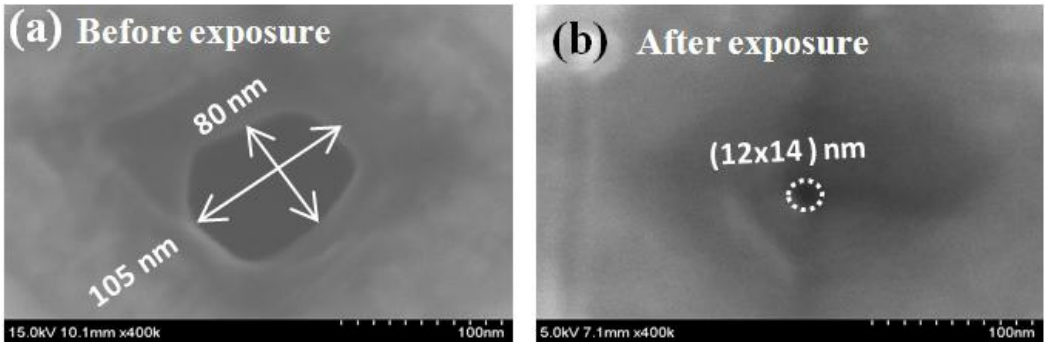

Figure 2: Reduced diameter of the aperture; the (105 x 80) nm diameter of Au aperture in Fig2.(a) is decreased to (12x14) nm in Fig2.(b). Upon the 20 keV electron beam exposure with ~10 μA for 3 minutes. The SEM image was taken after 80 minutes cooling in ~ 10^{-8} torr vacuum.