NANYANG TECHNOLOGICAL UNIVERSITY
School of Electrical & Electronic Engineering

OPTIMUS PHOTONICS
OPTIMUS – Centre for OptoElectronics and Biophotonics

Fabrication of Gold nano-dots for Sensing by Surface Enhanced Raman Scattering

Low-cost Development of Substrates with Sub-50-nm Gaps

Methodologies

By a phenomenon known as surface-enhanced Raman scattering (SERS), nanoroughened substrates offer giant field enhancement for high sensitivity detection of weak Raman scattering. Since the discovery of SERS, the use of corrugated noble-metal surfaces or nanoparticles as a biosensing tool has gained popularity. In addition to molecular fingerprinting with SERS, the narrow spectral width permits multiplexed detection.

Most SERS substrates are composed of metallic colloid or patterned solid surfaces. In particular, periodic nanostructures capable of sustaining reproducible field confinements and highly intense fields are necessary in SERS. Finite Difference Time Domain(FDTD) simulation demonstrate tremendous SERS enhancement in sub-50nm gap. Here, we investigate the use a thin (200nm) porous Anodised Aluminium Oxide(AAO) through-hole membrane as a deposition mask to fabricate SERS substrate with high density of sub 50nm gaps. Briefly, AAO membrane consist of an periodic arrays of cylindrical channel which can be achieved by a self-ordering anodisation process of high purity aluminium substrate. The aluminium body was stripped off follow by a wet etching process to remove the barrier layer to obtain a through-hole AAO membrane which is then attached onto a silicon chip Titanium followed by Gold is deposited through the membrane using a Electron Beam Evaporator, after which the AAO membrane is removed chemically revealing a periodic arrays of gold dots.

Experimental setups & Results

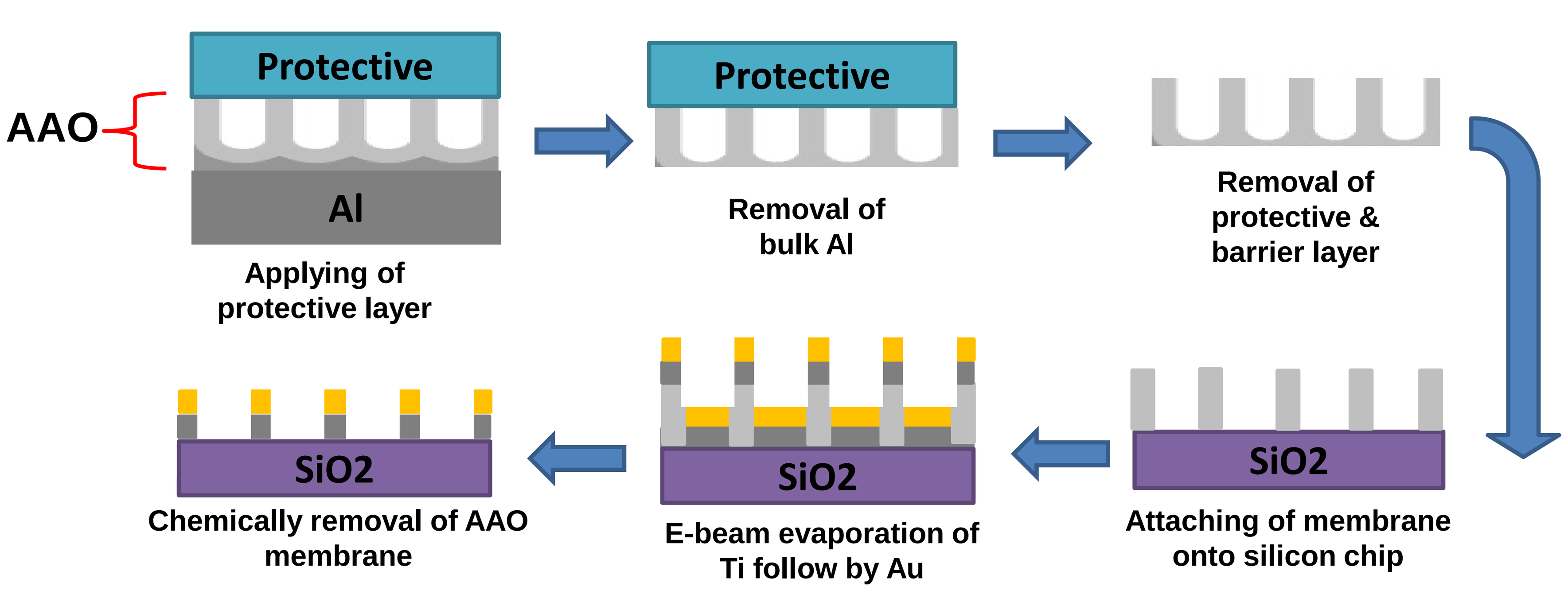

Fig. 1. Schematic representation of fabrication process

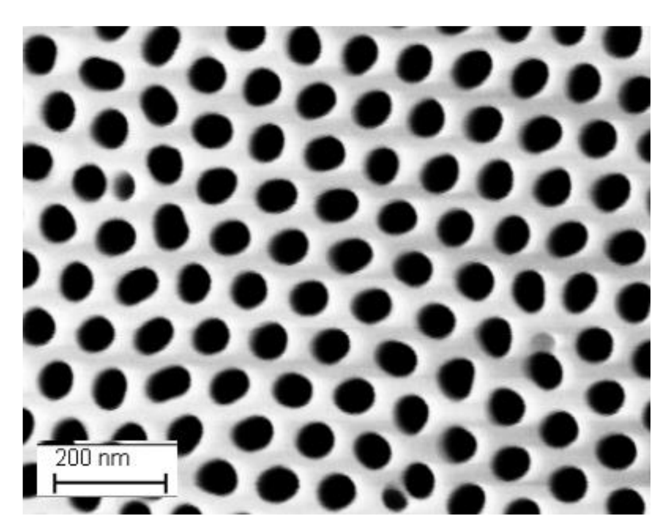

Fig. 2. SEM image of AAO membrane after 40 min of wet etching in phosphoric acid

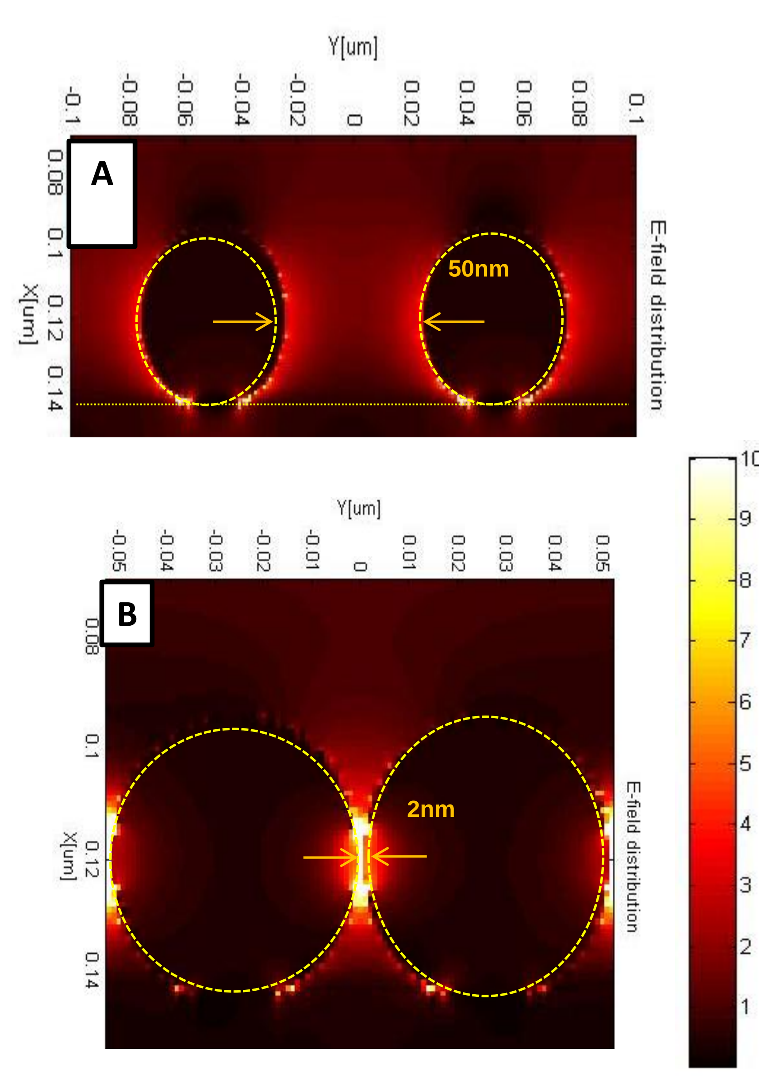

Fig. 3. FDTD simulation of the intense field enhancement as the gap between two gold sphere decreases from (A) 50nm gap to (B) 2nm.

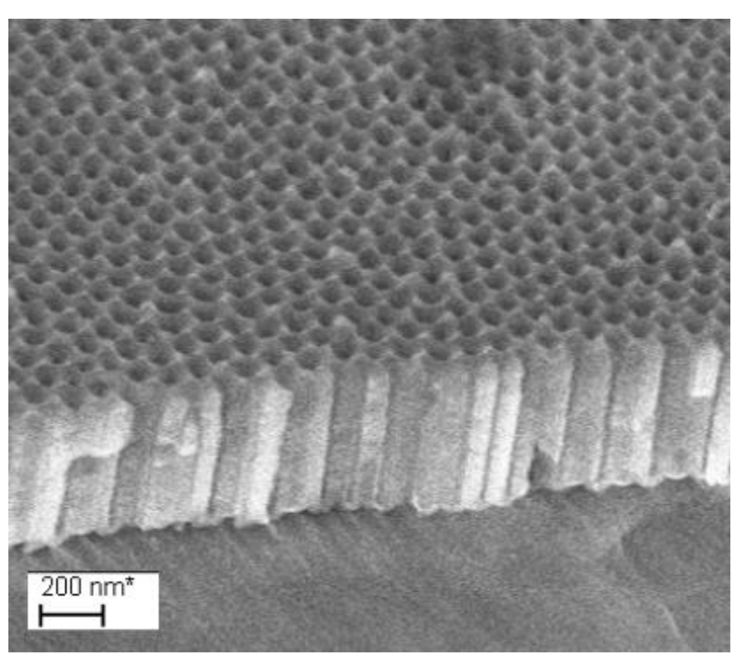

Fig. 4. Cross sectional SEM image of AAO demonstrating the straight channel of the periodic arrays .

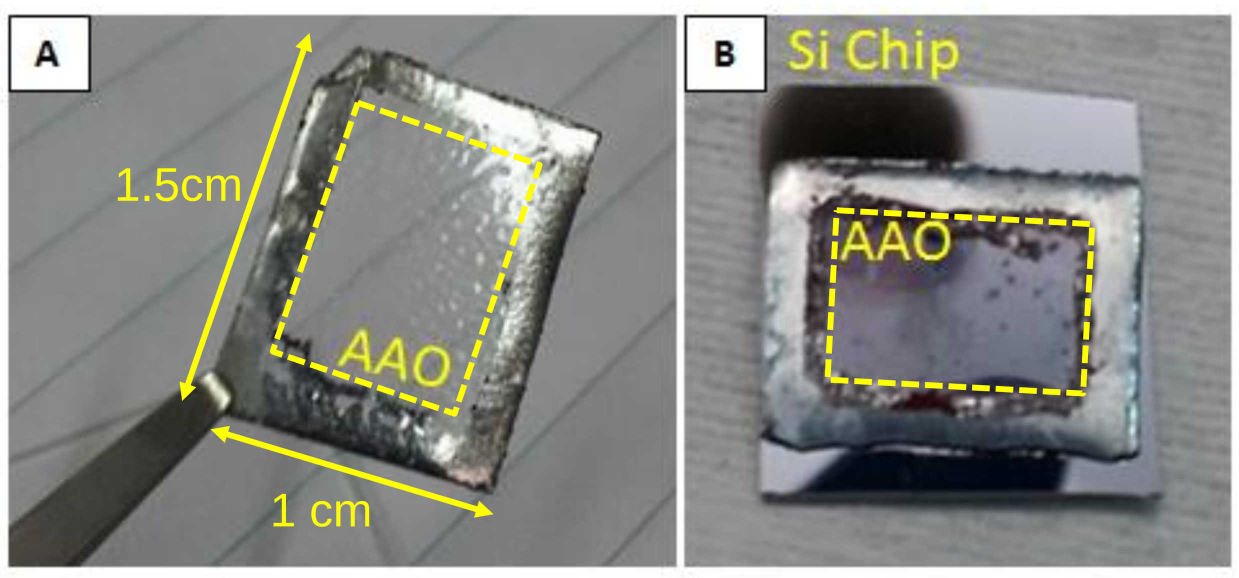

Fig. 5. A) Showing the translucent AAO membrane after removal of the protective and barrier layer. B) Showing the attachment of AAO membrane onto a Silicon chip

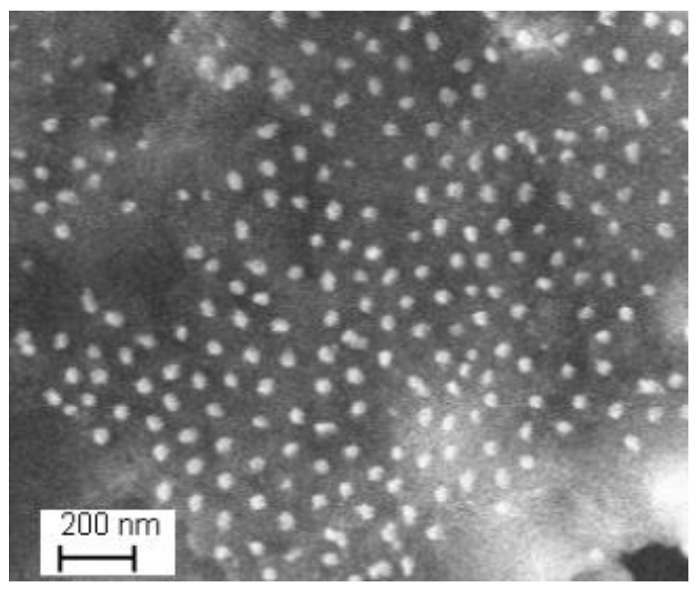

Fig. 6. SEM image of gold nano-dots after removal of the AAO membrane showing a hexagonal arrangement

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