Development of micro- and nano-structured LSPR chip for label free single cell assay

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Intensive study on single cell monitoring and its secreted protein is very important to precisely observe any infectious diseases in the human body system. Microwells array becomes new versatile platform for high throughput for cell secret and continuous long-term monitoring. Thousands of individual cells can be trap within certain perimeter of area by simple gravitational sedimentation. Individual cell response from each cavity can provide important data for drug testing, toxicology and basic cell biology application. In this study, we propose label free single cell microwell array made of SU-8 as mirco-structure that integrated with gold nano structure for localized surface plasmon resonance (LSPR) application.

Microscope glass was cleaned using hydro fluoride (HF) acid for 10 second before washed with excess deionized water (DI). SU-8 3050 was dispersed on cleaned glass before spin coat at 2300 rpm. After soft bake treatment, glass was further exposed under ultra violet rays for 30 seconds. Unexposed area was further removed with SU-8 developer for 10 minutes. SU-8 micro-structure well of 60µm depth and diameter 60µm was observed using surface profiler. Simultaneously, silica nanosphere with constant diameter of 100nm was stirred 24hours with 1% (v/v) 3-Aminopropyltriethoxysilane (γ-APTES) solution. Prepared solution was centrifuge at 3500 rpm for 1hour before γ-APTES solution was removed and replaced with ultra pure water. Both washing and centrifuge procedure was repeated 3 times. At the same time, cleaned glass substrate was sputtered with Titanium (Ti) layer of 5nm and Gold (Au) layer of 40nm. Prepared substrate was introduced with 1mM of 4,4-Dithiodibutyric acid (DDA) solution to form self assemble monolayer (SAM) for 1hour before activated with 400mM of 1-Ethyl-3-(3-dimethylaminopropyl)carbodiimide (WSC) solution for 1 hour. Surface modified nanosphere was exposed to the SAM for 1hour before excess nanosphere was washed with DI water. Finally, second time sputtering of Au was preformed with 30nm thickness to form LSPR plasmonic sensing device.

Sensitivity of resultant plasmonic device was further evaluated over various surrounding refractive index environments. This includes air (n=1.0), water (n=1.33), 1M glucose (n=1.35), ethylene glycol (n=1.43) and glycerol (n=1.47). Our plasmonic device shows red-shifted behaviour as surrounding refractive index value increase. The sensitivity shift value was obtained at 107nm/RIU. New effort is taken to change substrate used and sensing material to obtain higher sensitivity in future. Further progress on the sensing device will be present and discuss during the conference.

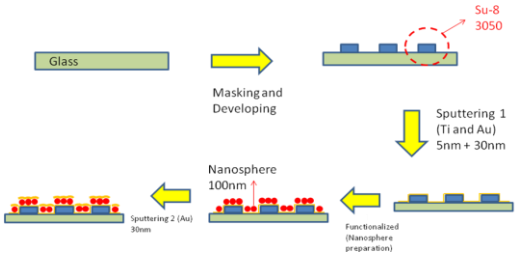

Figure 1 : The fabrication workflow.