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Fabrication of nano pillar-structured LSPR sensor chip via RT-nanoimprint lithography

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[Background] LSPR has attracted attention in developing bio-sensor chips for POCT application as a highly sensitive label-free measurement method. The reliable LSPR substrate can be achieved by using nanoimprint technology with a self-ordered anodic aluminum oxide (AAO) as a mold which was chosen for its high-ordered honeycombed nanostructure. The fabrication of Au-capped nano-pillar bio-chip by using thermal nano-imprint technology was successful as reported in our previous work. In general, thermal nanoimprint that uses a thermoplastic resin, optical nanoimprint that uses a UV-curable resin are widely-used methods, but accuracy degradation due to shrinkage and material deterioration at the time of molding could occur to these methods both. Whilst, hydrophobic surface used in these methods are often not suitable for sensing of the water-based sample, and furthermore, equipments for thermal and optical nanoimprint are also large and expensive. To fix these inconveniences, in this work, room temperature nanoimprint technology will be demonstrated. Unlike conventional NIP technology, room-temperature nanoimprint is possible to easily mold the nanostructures at low cost by using polymer gel-material.

[Experiments] AAO substrate fabricated via 80V Multi-stage anodization was employed as a nano-patterned mold in thermal-nanoimprint procedure with cyclo-olefin polymer (COP) chip. Once, the nano-pillar COP chip is obtained, pouring PDMS onto it could make a porous PDMS mold for RT-nanoimprint lithography formed. After removing the PDMS mold (thickness=5mm), we observed it via AFM (Fig.1). And by dropping room-temperature curable polymer onto slide glass, covering PDMS mold above firmly and keeping a 0.55N pressing force for over 5 hours then remove the PDMS mold will fabricate a nano-pillar pattern as shown in Fig.2. The LSPR chip will be accomplished after au sputtering. Afterwards, refractive-index response in different media has been tested. The peak shifts showed to be 137.43nm/RIU[air (RI=1) 549.33 nm, water (RI=1.33) 596.579 nm, 1 M glucose (RI=1.35) 598.592nm、ethylene glycol (n = 1.43) 602.814nm、glycerol (n = 1.47) 617.646nm]. For furthermore plan, we are considering introduction of specific molecular reaction detection to confirm its bio-sensing capability.

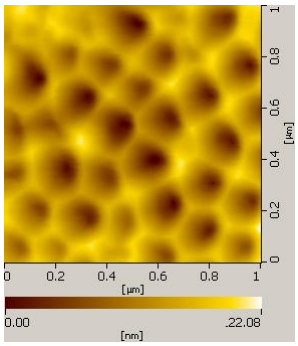

Fig.1 AFM image of PDMS mold

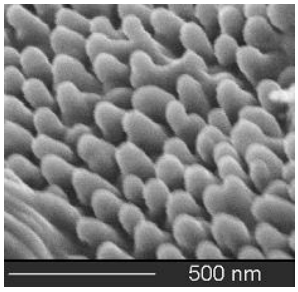

Fig.2 SEM image of RT-NIPed polyer-glass chip