圧力フリー常温ナノインプリント技術を利用したプラズモニックバイオセンサーの開発

Pressure-free nanoimprinting at room temperature for plasmonic biosensors

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[Background] Plasmonic biosensors, well known as LSPR-based or SERS-based, have driven numerous interests these years because of their superior immediacy, versatility, and high potential in sensitivity which make them applicable for POCT (Point-of-care testing) applications. All these good features are vitally determined by their exquisite nanoparticle or nanostructure characteristics. Currently trendy fabrication methods such as EBL, material deposition are either high-cost or not well functioned for large area formation, or not adaptable to plentiful morphology design, which make them hardly can be associated with POCT applications. Among various developed means, in this work we are going to reveal a method which is tunable, easy to scale up and possible of mass-production at low-cost via nanoimprint technology especially at room-temperature and using zero pressing force. Merits mentioned above fitly meet the needs of biosensor development also in terms of POCT application standards.

[Experiments] Nano-pillar structure on COP mold is firstly transferred from nano-porous anodic alumina oxide which is considered as the master mold in this work. The geometry of nano-porous structure can be manipulated via varying anodization conditions. Subsequently, secondary molding was performed by pouring liquid PDMS onto COP mold, in order to fabricate a thin nano-porous PDMS second mold with consistent dimensional features to the master mold. Finally, a high-viscosity gel was spin-coated onto a slide glass (SOG). With the perks of the narrowed thickness of PDMS, the thin, membrane-like mold would self-adhesively spread onto the surface and form SOG gel faithfully during the curing at room temperature. After removing the PDMS mold, nano-pillar structured SOG chip was sputtered with Au nanolayer.

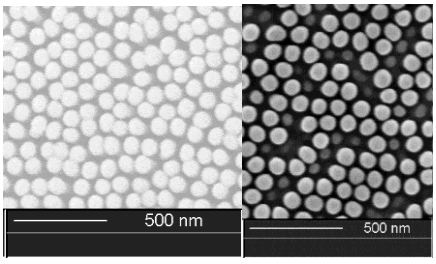

Fig1. SEM images of original COP mold (left); SOG chip (right)

[Results and discussion] As so far, nano-pillar structured SOG chip which is nanoimprinted without pressure at room temperature has been confirmed of holding reliably similar dimensional features and sensitivity (62~68 nm/RIU) to the original COP mold via SEM and refractive index response tests respectively. Furthermore, sensitivity enhancement by optimizing nanostructure geometry design and fabrication procedure is under discussion.

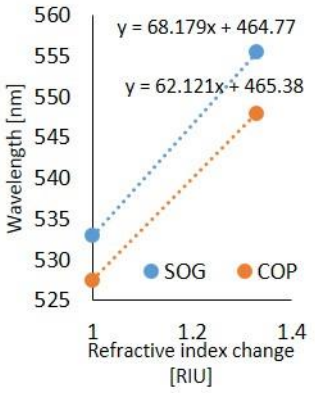

Fig2. RI change (air/ water) response tests results of both SOG and COP chips.