NT-P023

Fabrication of Optically Active Nanostructures for Nanoimprinting

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Optically active nanostructures such as subwavelength moth-eye antireflective structures or surface enhanced Raman spectroscopy (SERS) active structures have been demonstrated to provide the effective suppression of unwanted reflections as in subwavelength structure (SWS) or effective enhancement of selective signals as in SERS. While various nanopatterning techniques such as photolithography, electron-beam lithography, wafer level nanoimprinting lithography, and interference lithography can be employed to fabricate these nanostructures, roll-to-roll (R2R) nanoimprinting is gaining interests due to its low cost, continuous, and scalable process. R2R nanoimprinting requires a master to produce a stamp that can be wrapped around a quartz roller for repeated nanoimprinting process.

Among many possibilities, two different types of mask can be employed to fabricate optically active nanostructures. One is self-assembled Au nanoparticles on Si substrate by depositing Au film with sputtering followed by annealing process. The other is monolayer silica particles dissolved in ethanol spread on the wafer by spin-coating method. The process is optimized by considering the density of Au and silica nano particles, depth and shape of the patterns. The depth of the pattern can be controlled with dry etch process using reactive ion etching (RIE) with the mixture of SF6 and CHF3. The resultant nanostructures are characterized for their reflectance using UV-Vis-NIR spectrophotometer (Agilent technology, Cary 5000) and for surface morphology using scanning electron microscope (SEM, JEOL JSM-7100F). Once optimized, these optically active nanostructures can be used to replicate with roll-to-roll process or soft lithography for various applications including displays, solar cells, and biosensors.

Authors acknowledge that the research is supported by the MKE(The Ministry of Knowledge Economy), Korea, under the “IT Consilience Creative Program” support program supervised by the NIPA(National IT Industry Promotion Agency). (NIPA-2012-H0201-12- 1001)

Keywords: nanostructure, nanoimprinting, nanopattering, antireflective, SERS