Nanoplasmonics and surface enhanced spectroscopy

Fabrication of periodic Au plasmonic structures for enhancement of SPR sensitivity

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During the last decades the technique of surface plasmon resonance (SPR) has found wide use in areas such as the pharmaceutical industry, water safety testing, medical diagnostics and others. A recent study [1] has shown that by placing a sinusoidal profile grating in silver of appropriate period and depth on the rear face of a substrate used in the Kretschmann configuration, the SPR sensitivity may be enhanced when compared with an uncorrugated surface. Here we report the interference lithography (IL) technique with the use of resist based on the chalcogenide glass (ChG) films for fabrication of Au chips with periodic surface nanostructures for SPR refractometer.

The IL technique was optimized for patterning of the Au layer with spatial frequency up to 3000 mm^{-1} and depth of relief from 5 nm up to thickness of Au layer. Additional method for changing the shape of the grating grooves using annealing in vacuum was developed. After annealing at 400° C for 15 min the original rectangular shape of the groove profile with flat tops transformed into sinusoidal profile with an increase in the height of groove and its narrowing. Fabricated chips were tested on Dual channel SPR refractometer PLASMON-6. It was shown, that at wavelength of 650 mn the conditions of Bragg reflection of plasmons (which is a condition for enhancing of biosensor sensitivity compared to a flat surface) are satisfied at spatial frequencies of gratings near 3000 mm^{-1} for interface Au-air. For interface Au-water this condition is satisfied for the same spatial frequency at working wavelength of 850 mn. Based on the presented results we can conclude, that this IL method with additional annealing enabled the successful fabrication of corrugated SPR chips with desired characteristics (spatial frequency, depth of relief, a form of profile) on an area larger than 5 cm^2.

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1. *Alleyne C. J., Kirk A.G., McPhedran R. C., Nicorovici N-A. P. and Maystre D.* Enhanced SPR sensitivity using periodic metallic structures // Opt. Express.-2007.- **15**.- P. 8163-8169 .