Nanoplasmonics and surface enhanced spectroscopy

Nanostructured Au chips with enhanced sensitivity for SPR sensors

I.Z. Indutnyi, Yu.V. Ushenin, V.I. Myn'ko, P.E. Shepeliavyi, M.V. Lukaniuk, A.A. Korchovyi, R.V. Khrystosenko

V. Ye. Lashkaryov Institute of Semiconductor Physics NAS of Ukraine
Prospect Nauki, 41, Kiev-03028, Ukraine
E-mail: indutnyy@isp.kiev.ua

Surface plasmon resonance (SPR) devices has found wide use in recent years in biosensing applications due to its advantages of high sensitivity, label-free, real-time and rapid detection. Here we report experimental study of the enhanced sensitivity of SPR refractometer by forming a periodic relief in the form of grating on the surface of SPR Au chip. Periodic relief of different depth with a spatial period 296,7 ± 0,5 nm was formed on the Au films surface using interference lithography and vacuum chalcogenide photoresists. Measurements of angular dependences for light reflection (reflection curve) from the interface analyt/gold film on glass substrate were performed using the SPR refractometer Plasmon-71 (V. E. Lashkaryov Institute of Semiconductor Physics NAS of Ukraine) with working wavelength of 850 nm. In this work, the solutions of glycerol (refractive index n = 1.474 at 20 ° C) in water (n = 1.333 at 20 ° C) were used for determining the sensitivity of the sensor structures, i.e. the influence of the refractive index of environment on the shift of SPR minimum. The mass concentrations of glycerol solutions were changing from 34 to 64 %, with the refractive index changing from 1.37 to 1.42. The period of the grating was chosen to provide the proximity to Bragg reflection of polaritons in this environment.

It was found that enhancement of the refractometer sensitivity and the value of the interval of environment refractive index variation Δn in which there is this enhancement, depend on the depth of the grating relief. By increasing the depth of the relief the width of the working interval Δn decreases and sensitivity increases from 110 deg./ RIU for a standard chip (where RIU - refractive index unit), up to 154 deg./ RIU and 365 deg./ RIU for structured chips with the depth of the relief equal to 11.7 ± 2 nm and 18.5 ± 2 nm, accordingly.

The results of measurement confirm the predictions of the theory about increase sensitivity of SPR biosensors by forming the grating of corresponding period and the depth of the relief on the working surface of the sensors chip.

The authors gratefully acknowledge that parts of this work have been funded by the Swiss National Science Foundation (SNSF, Bern) under grant no. IZ73Z0_152661 (SCOPES).