Study of surface plasmon polarization conversion with Au surface-relief gratings

I. Indutnyi, V. Myn'ko, M. Sopinskyy

V.Lashkaryov Institute of Semiconductor Physics, National Academy of Sciences of Ukraine, 41, prospect Nauky, 03028 Kyiv, Ukraine,

Corresponding author: indutnyy@isp.kiev.ua

The effect of polarization conversion (PC) caused by excitation of surface plasmons on metal gratings was studied in many theoretical and experimental works. However, these studies mainly concerned the samples with spatial period (d) greater than the excitation wavelength (λ). Here we report the results of experimental studies of plasmon-stimulated PC for Au gratings with different d/λ ratios and different relief depth (h).

The samples were prepared by interference lithography based on chalcogenide glass photoresist ($As_{40}S_{40}Se_{20}$). After exposure of $As_{40}S_{40}Se_{20}$ layer by interference pattern formed with a He-Cd laser, the samples were chemically treated to form gratings with desired characteristics. The gratings were coated by vacuum thermal evaporation with thin MgF_2 layer, then with opaque (80 – 100 nm) Au layer. Prepared samples were characterized morphologically using a Dimension 3000 Scanning Probe Microscope.

The PC efficiency was characterized by the ratio (R_{ps}) of the intensity of the S-polarized component in the specularly reflected light to the intensity of the incident P-polarized radiation of the He-Ne laser (λ = 632.8 nm). Investigation of R_{ps} as a function of the incidence angle (θ) and/or the azimuth angle (φ) was carried out on an optical stand mounted on the basis of the G5M goniometer.

It has been established that for low frequency gratings with $\lambda/d < \sqrt{2}$ the maximum of R_{ps} is reached at $\varphi \approx 45°$ and is determined by the grating modulation depth (h/d). When increasing the ratio h/d of such grating to 0.14, the value of R_{ps} increases monotonously. However, for high-frequency gratings (for which λ/d is close to 2), the R_{ps} value is an order of magnitude smaller than the corresponding values for low-frequency gratings with the same h/d. This may be due to the fact that for high-frequency grating surface plasmon and, respectively, R_{ps} are excited at large incidence angles ($\theta > 60°$).

Efficient and stable hybrid solar cells of nanostructures and bulk heterojunction Organic semiconductors

K. S. Ram and J. Singh

College of Engineering, IT and Environment
Charles Darwin University, Darwin, NT 0909, Australia

Corresponding author: jai.singh@cdu.edu.au