Nanooptics and photonics

Enhanced surface plasmon-polaritonic sensitivity in the structures based on corrugated thin metal films with quasi-anticorrelated reliefs

M.L. Dmitruk[1], O.V. Korovin[1], S.V. Mamykin[1], V.I. Myn'ko[1], M.V. Sosnova[1]

[1] V. Lashkaryov Institute of Semiconductor Physics, NAS of Ukraine.
41, Prospect Nauky, Kyiv, 03680, Ukraine.
E-mail: sosnova@isp.kiev.ua, mamykin@isp.kiev.ua

One of the realizations of high-sensitive active sensors is based on the grating coupler effect for the excitation of surface plasmon polaritons (SPP) in surface-barrier heterostructures with Schottky barrier on the frontal surface of metal-semiconductor contact with periodically profiled metal film interfaces. Current technology of the diffraction grating formation on the semiconductor substrate (GaAs, Si) with following deposition of the metal (Au) film is based on the holographic photolithography [1]. In this case, the deposited metal film possesses the same reliefs at both sides of the film. Moreover, this technology leads to an additional surface recombination in the Schottky barrier. Recently, it was shown that a geometrical interrelation between metal film reliefs leads to the increasing of coupling for SPPs at opposite interfaces of this film with the transformation of a SPP peak shape from Lorenz type for films with correlated interfaces to Fano type for anticorrelated interfaces [2]. In this work, we analyzed sensitivity of surface-barrier heterostructures based on Schottky barrier with a periodically corrugated thin metal film with quasi-anticorrelated reliefs (film thickness is a function of planar coordinate) where the diffraction grating is formed only on the external interface of metal film while the "metal-semiconductor" interface is flat. On the one hand, the periodically varied thickness of metal film leads to SPP excitation with Fano shape peaks in transmittance (photocurrent). On the other hand, the flat metal-semiconductor interface essentially decreases surface recombination unlike previous technology [1]. Thus, the main advantages of such heterostructures are (i) the reducing of surface recombination losses that improve photodetector properties of active plasmonic sensors and (ii) the enhancing of their sensitivity in the spectral region near quick dropping side of Fano-like SPP resonance peak.

1. *Dmitruk M.L et al.* Influence of sulfide treatment of profiled-interface Au-GaAs Schottky diodes //Technical Physics Letters.-1997.-**23 (5)**.-P.355-357.
2. *Dmitruk N.L., Korovin A.V.* High light transmission through thin absorptive corrugated films // Optics Lett.-2008,- **9**.-2008.-P.893-895.