PLASMON- PHONON INTERACTION IN $Mg_xZn_{1-x}O$/SiC STRUCTURES: EFFECT OF CHEMICAL COMPOSITION AND THICKNESS OF THE FILM

Oleksandr Melnichuk[1], Lyudmyla Melnichuk[1], Nadiia Korsunska[2], Larysa Khomenkova[2,3], Tetyana Torchynska[4]
[1]Mykola Gogol State University of Nizhyn, Department of Physics, Ukraine. [2]V.Lashkaryov Institute of Semiconductor Physics at the National Academy of Sciences of Ukriane, Laboratory of multifunctional composite materials, Ukraine. [3] National University - Kyiv- Mohyla academy, Physics and Mathematics, Faculty of Natural Sciences, Ukraine. [4]Instituto PolitÃ©cnico Nacional - IPN, ESFM, Mexico.

$Mg_xZn_{1-x}O$ offer unique properties such as high photosensitivity, high photo- and cathodoluminescence yields, piro- and piezoelectric effects, etc. Among different substrates, optically anisotropic uniaxial polar semiconductors such as silicon carbide (6H polytype) are preferable. They allows not only to extend the field of the application of such films, but also to study their optical and electrophysical properties by means of surface polariton spectroscopy (SP) and infrared reflection (IRR) method. The $Mg_xZn_{1-x}O$ films with 0.05- 20 µm thickness were deposited on semiconductor 6H-SiC substrates by electron- beam evaporation method. They were investigated by means of SP and IRR methods in the range of residual rays of the film and substrate (400- 1200 cm^{-1}) with orientations E?*C* and E||C at room temperature. The film composition determined its structural properties. The films with *x*>0.2 showed cubic lattice structure, whereas the films with *x*?0.2 demonstrated hexagonal lattice structure and anisotropic optical properties in the IR spectral range. Besides, the electron concentration in the film was found to vary with *x* in the range 1×10^{16}- 5×10^{18} cm^{-3}. To simulate IRR and SPS spectra, the mathematical model with additive and phenomenological contribution of oscillators to dielectric permittivity of the materials was developed. To analyse the spectra, the orientation of the optical axis in the film and the substrate as well as the phonon and plasmon- phonon interactions in the film and substrate, respectively, were considered. For the first time, the surface polariton spectral range and dispersion laws as well as corresponding damping coefficients were determined. For the $Mg_xZn_{1-x}O$ film, the frequencies and damping coefficients of the TO and LO modes of all oscillators, the dielectric contribution of each mode, static and high-frequency dielectric permittivity for orientations *E?C* and *E||C* were obtained with high accuracy. It was shown that for the films thinner 90 nm, more precise information can be extracted from the SP spectra, whereas for the thicker films (?5 ?m) the IRR spectroscopy is more useful. The results obtained showed that proposed non- destructive method can be implemented for the determination of optical properties of other semiconductor films.

Keywords: MgZnO, plasmon- phonon interaction, surface polariton

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Presenting author's email: mov310310@gmail.com