Influence of Ag Nanofilms on the Optical Properties of $LiNbO_3$

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Lithium niobate (LN) single crystals are very interesting and attractive material, which widely used for designing and production of opto- and acoustoelectronic devices variety. LN has anomalously high pyroelectric, electrooptic and acoustooptic coefficients and thereby can be used for fabrication of optical devices [1]. Technology for formation of photonic crystals using vacuum deposition of microstructures on the LN surface rapidly develops during last years [2]. Experimental investigation of microstructures deposited on the dielectric matrix shows that they greatly influence a linear and none-linear permittivity of the substrate [3, 4]. We expect that formation of metallic microstructures on the LN surface will lead to similar effect and thus application of this material will be expanded. In this paper we will analyze morphology of Ag-nanoparticles on LN surface as well as their influence on the surface properties.

Ag-nanoparticles are prepared by magnetron sputtering in vacuum using COM-TH2-SP2-ION deposition equipment (TORR Corp., USA). LN substrates had dimensions 16×8×0.8 mm. Thickness of nanofilms deposited at rate 0.7 Å/s and temperature 50° C was varied from 1 till 4 nm. The structure of the surface was investigated by Atomic Force Microscope NT-MDT SolverPro 47 in semi-contact mode by the NSG10 tip with the radius of ~10 nm. Optical spectra were measured using the two-beam spectrophotometer Shimadzu UV-3600 in the 300…2000 nm spectral band with the step of 1.0 nm and spectral slit width of 2.0 nm. For study of nonlinear optical effects of the LN with Ag films it has been used a conventional Z-scan technique developed by Sheik-Bahae [5].

It has been observed significant changes in nonlinear properties of LN in particular the nonlinear refraction of the silver nanoparticles, which are present on the substrate. It should be noted that these changes as well as a position of plasmon absorption peak of the silver nanofilms deposited on the LN substrate [6] depend essentially on the sign of electric charge on the crystal surface. This phenomenon can be used to determine easily the charge sign on the LN surface.

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