We estimate now the magnetostriction sensitivity. The total winding resistance of all four rods was 3 Ω, so that the magnetostriction transfer coefficient was $K_m \Delta L/dU = 10^{-5}/7.2 = 1.4 \cdot 10^{-6}$ m/V. As already noted, the transfer coefficient of a standard P1 piezoceramic is $K_p = 3 \cdot 10^{-9}$ m/V. The transfer-coefficient ratio is then $K_m/K_p = 1.4 \cdot 10^{-6}/3 \cdot 10^{-9} = 4 \cdot 10^2$. Thus, compensation of the perturbed cavity length by using magnetostriction offers the following significant advantages over the electrostriction method: a) a substantially larger dynamic range; b) the magnetostriction transfer coefficient is larger by more than two orders than that of the electrostriction actuating element; c) the frequency tuning is effected without adversely affecting the mechanical properties of the cavity, since the invar rods are structural elements of the cavity.

The magnetostriction coefficient was successfully used in experiments on laser-frequency stabilization [3, 4]. The AFC system [5] consisted in this case of two loops — fast and slow. The rapid and slow loops had piezoceramic and magnetostrictive actuating elements, respectively. The use of such a system yielded unprecedented values of long-and short-time frequency stability [3, 4].

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LITERATURE CITED


REFLECTING PHASE VOLUME HOLOGRAPHIC GRATING (PVHG) IN LiNbO₃

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The spectral-angular selectivity of reflecting PVHG in LiNbO₃ and electric control of light diffraction are investigated. It is shown that a PVHG with approximate 7000 lines/mm and thickness spatial frequency 3.7 mm has a spectral selectivity 0.023 nm and angular selectivity that varies in the range from 2 to 50 ang. min, depending on the angle between the beams that record the grating. Application of an 850 V electric field decreases the diffraction effectiveness by one-half for an extraordinary wave and a transverse scheme (the transverse dimension of the PVHG is 5 mm). It is established that the spectral-angular characteristics of reflecting PVHG and electric control of light diffraction can be described within the framework of the theory of coupled wave and the electrooptical effect.

Phase volume holographic gratings (PVHG) in ferroelectric crystals are promising selective elements for tunable lasers, in view of their high diffraction efficiency and polarizing ability, high spectral and angular selectivity, and also their ability to control light diffraction electrically.

The most thoroughly studied at present are transmitting PVHG in LiNbO₃. At a crystal thickness d = 14 mm and a grating period $\Lambda = 0.69$ μm (spatial frequency $\chi = 1450$ lines/mm), the following PVHG parameters were measured in [1]: diffraction efficiency $\eta = 65\%$, angular...
Fig. 1. Optical diagrams: a) Writing the reflecting PVHG in LiNbO₃. ρ₁, ρ₂ - vectors of interfering waves, Λ - period of interference pattern (PVHG) (the subscript "a" refers to air). b) Diffraction of light by reflecting PVHG when the Bragg condition is exactly satisfied. (⃗ρ - ⃗σ = ⃗K) ⃗ρ, ⃗σ - wave vectors of incident and diffracted waves, respectively, ⃗K - grating vector, ⃗C - polar axis of ferroelectric crystal, ⃗n - vector normal to the crystal.

selectivity 2Δθ_a = 22 ang. sec (in air), and spectral selectivity 2Δλ = 0.14 nm. This grating was used to select the frequency and spatial spectra of Rhodamine-B dye-laser emission [2].

More promising for laser tuning are reflecting PVHG, which have, other conditions being equal, a substantially higher spectral selectivity and considerably lower noise [3] than transmitting gratings. Another advantage is their higher sensitivity when it comes to controlling light diffraction by means of an electric field [4, 5]. The kinetics of holographic recording and the angular selectivity of reflecting PVHG were investigated in [6]. At an angle 170° between the writing beams (7000 lines/mm) and at a crystal thickness 5 mm, a selectivity 2Δθ_a = 30 ang. min was measured and it was estimated that 2Δλ ~ 0.6 nm. These results, however, differ by several times from the data of the theory proposed by Kogelnik [7] to describe PVHG.

We have investigated the spectral and angular selectivities of PVHG in LiNbO₃ and electric control of light diffraction. The experimental results were compared with data obtained on the basis of Kogelnik's theory.

SPECTRAL AND ANGULAR SELECTIVITIES OF REFLECTING PVHG IN LiNbO₃

The phase detuning parameter ξ, which characterizes the deviations δθ and δλ from the Bragg conditions in angle and wavelength, respectively, is of the form

\[ ξ = m_c,σ \left[ \sin \alpha \sigma + \cos^2 \left( \phi / 2 \right) \sigma \cos^2 \left( \phi / 2 \right) / \lambda C_o \right], \]

where n_c,σ is the refractive index of the crystal for the extraordinary or ordinary wave, d the PVHG thickness (Fig. 1a), λ the wavelength of light in air, \( \alpha \) the complementary angle between the writing beams in the crystal, \( C_o = \cos \theta - \cot \phi / \lambda n_c \); \( \phi \) the angle of incidence of the reading beam in the crystal (Fig. 1b), and \( \epsilon \) the grating inclination angle.