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Faraday isolator based on NTF crystal in critical orientation

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Abstract

The characteristics of a magneto-optical material promising for the development of Faraday isolators for high-power lasers - the Na0.37Tb0.63F2.26 (NTF) solid solution crystal with a negative value of optical anisotropy parameter - were investigated. The value of the optical anisotropy parameter ζNTF = -0.26 ± 0.02 was refined in model experiments on samples with increased absorption, and the value of the thermo-optical constant Q characterizing thermally induced depolarization was measured to be QNTF = (3.44 ± 0.4)·10-6 K-1. The negative value of ζ indicates that the depolarization resulting from stress-induced birefringence in this material is strongly dependent on orientation and ensures the presence of a critical orientation [C], with the use of which the magnitude of thermally induced depolarization in the Faraday isolator may be significantly reduced. The [C] orientation is determined by the parameter ζ; therefore, its accurate measurement is of particular importance. The investigation of Faraday isolators based on NTF crystals cut in [001] and [C] orientations demonstrated a significant advantage of the critical orientation. According to the measurement result, with the use of crystals with normal absorption, it is possible to develop a traditional (single element) Faraday isolator operating at room temperature and ensuring the isolation ratio of about 30 dB at the laser radiation power of ~7 kW. This makes the NTF crystal one of the most prospective magneto-active media.

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