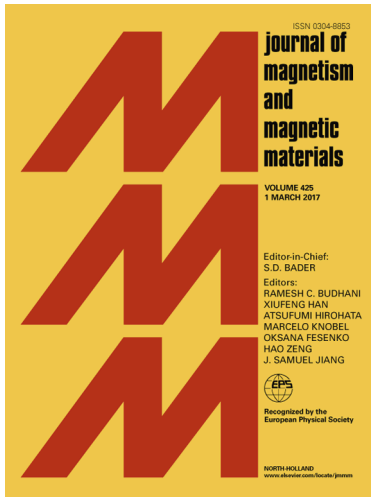

Faraday effect control in graphene-dielectric structure by optical pumping

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Faraday effect control in graphene-dielectric structure by optical pumping

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Abstract

At the terahertz frequency range, 2D material graphene is the most promising candidate for using as a functional part of magnetooptical devices because of discovered giant Faraday rotation and ability to dynamical properties control. In this paper magnetooptical properties of graphene were investigated. Numeriacal analysis on graphene-dielectric structure have shown the tunability of Faraday rotation and ellipticity in terms of amplitude and frequency by optical pumping of different radiation power and wavelength. Our work demonstrates alternative way for developing ultrafast optically tunable polarization modulatiors of THz wave.

Keywords:
Faraday rotation, graphene, terahertz, photonics devices

1. Introduction

Terahertz (THz) technologies have high potential for application in spectroscopy, imaging and diagnostics, security systems and high-speed communications [1]. Although scientists create new devices for generation [2, 3], manipulation [4, 5] and detection [6] of the terahertz radiation, but, nevertheless, many terahertz devices still exhibit insufficient efficacy still or simply absent [7]. One of the less developed research directions is active terahertz polarization optics, which is intended to fast modulation of terahertz radiation polarization. As is known, the polarization is one of the four basic properties of electromagnetic waves, and it plays the important role in various optical systems and devices such as liquid crystal displays, optical communications and imaging [8–13]. Polarization devices include polarization converters, modulators and isolators (optical diodes, devices enabling unidirectional light propagation). But polarization materials and methods used for infrared and visible spectral range are inapplicable for terahertz frequency range. For this frequency range now there are actively used artificial structures (metamaterials) that control electromagnetic waves in ways not possible with natural materials [14–19]. Most of existing THz quarter-wave plates based on metamaterials show excellent characteristics basically only at one frequency. This problem is attributed to dependence of the operating frequency on physical dimensions of the metamaterial unit cell.

Special attention in terahertz polarization optics is paid to the Faraday effect. The Faraday rotation is a longitudinal magneto-optical effect. The gist of this effect is in rotation of the polarization plane of light beam that propagates through a transparent medium, which is located in a magnetic field. The most interesting feature of Faraday rotation is its nonreciprocity. The