Magnetorefractive effect in magnetic nanocomposites

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Magnetorefractive effect (MRE) is a new magneto-optical effect in nanostructured magnetic materials with giant, tunnel or colossal magnetoresistance [1,2]. The effect consists of changes in optical properties of systems with large magnetoresistance when they are magnetized. MRE is a frequency analogue of magnetoresistance and therefore its main mechanism in nanocomposites with tunnel-type magnetoresistance is high frequency spin-dependent tunnelling. We report on recent results of theoretical and experimental investigations of MRE in nanocomposites in the infrared wavelength region 5-20 mm. By considering the tunnel junction between adjacent granules as a capacitor and using Fresnel formula, we obtain simple relations for MRE in reflection and transmission modes for s-and p-polarization of light. The most of obtained experimental data for MRE in nanocomposites Co-(Al-O), CoFe-MgF, CoFeZr-SiO_n , Co-(Ti-O), Co-(Si-O) are consistent with the theory. The MRE amplitude is between 0.1 and 1.5% depending on magnetoresistance and optical constants. It confirms that spin-depending tunnelling exists at least up to infrared frequencies. The huge, two orders of magnitude larger in comparison with traditional magneto-optical effects, values of MRE in metal-insulator granular alloys with tunnel-type magnetoresistance makes MRE very promising for magneto-optical applications.

[1] J.C. Jacquet and T.Valet, MRS Symp.Proc. 384 (1995) 477.
[2] A.B. Granovsky et al. JETP 96 (2003) 1104.

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