Faraday effect and magnetogyration in superlattices in the long wavelength approximation

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Practically all of the realized experimentally crystal layered-periodic structures or superlattices (SL) can exhibit induced gyrotropy properties. As far as we know, the given phenomenon in SL has not been studied. The subject of the paper is the investigation in the long wavelength approximation (LWA) of linear Faraday effects: ordinary and induced (in presence of additional controlling electric field [1]), and linear magnetogyration in SL.

In the LWA the wavelengths of electromagnetic waves are significantly large compared to the SL period and SL can be considered as a homogeneous medium with some effective characteristics. Effective tensors describing the Faraday effect and magnetogyration were determined on basis of the methods [2] and material equations [3]. We also used the usual boundary conditions [4] and the fact that in the LWA electromagnetic field does not change at distance of the SL period order.

The relations for determining all the components of effective third rank pseudotensors (for ordinary and induced Faraday effect) and tensors (for magnetogyration) describing the enumerated phenomena at arbitrary layers crystallography symmetry have been derived. Particularly, the given tensors for SL originated by cubic crystals of $GaAs$-type have been investigated. In such SL the form of the ordinary Faraday effect tensor is similar to that of some classes of uniaxial crystals. Symmetry properties of induced Faraday effect have no analogues among monocrystal media and these properties are intermediate between ones of cubic and uniaxial crystals. It was shown that registration of the dependence of polarization plane rotation angle on magnetic field strength on the longitudinal Faraday effect allows us to determine (control) the relative thicknesses of the layers originating SL. The opportunities of creating on the basis of SL materials with the given magnetogyration characteristics have been ascertained.

References

[1] Novikov M.A., *Kristallografiya* (in Russ.). 1988. V. 33. N. 5. P. 1189.
[2] Djafari Rouhani B., Sapriel J., *Phys. Rev. B.* 1986. V. 34. N. 10. P. 7114.
[3] Fedorov F.I. *Theory of gyrotropy.* (in Russian). Minsk. 1976. 456 pp.
[4] Semchenko I.V., *Kristallografiya* (in Russ.). 1990. V. 35. N. 5. P. 1047.