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# Analytical modelling of μ and ε-isotropy effects in superlattices

**E.G. Starodubtsev**

Department of Automation and Information Systems, Gomel State Technical University, 48 October av., 246746 Gomel, Belarus

e-mail: starodub@tut.by, Phone+375-232-400027, Fax: +375-232-479165

Monocrystal anisotropic and bianisotropic media can be characterized by magnetic permeability (μ) or dielectric permittivity (ε) tensors with coincident for a definite light frequency principal values. In this case we have effects of magnetic (dielectric) isotropy of a medium, which are used at development of various devices for controlling spectral and amplitude electromagnetic waves characteristics and at disclosure and investigation of new optical phenomena. At presence of μ (ε) – isotropy many delicate crystal optics effects become apparent most strongly, as their masking by the medium magnetic (dielectric) anisotropy disappears.

Effects of μ (ε) – isotropy in monocrystals are rather rare, as the corresponding conditions for tensors μ, ε components are very rigid and determined only by the nature of a crystal. There are more possibilities of μ (ε) – isotropy effects realization for layered-periodic structures or superlattices (SL), as the layers properties and geometry varying allows operating effective magnetic and dielectric SL properties (a particular case of ε – isotropic SL from uniaxial components was considered in [1]).

The work aims at investigation of μ (ε) – isotropy general conditions for short-period layered-periodic structures or SL. Analytical and numerical modelling of SL effective tensors μ, ε are carried out in frames of the long wavelength approximation for electromagnetic field. SL originated from arbitrary crystallographic symmetry components characterized both by symmetric, and non-symmetric tensors μ, ε are considered. Particularly, it is shown that in case of two-component SL μ (ε) – isotropy general conditions represent a system of two equations (of the firth and the sixth order) relatively to parameter $x=d_1/D$, where $d_1$ is the first layer thickness, $D=d_1+d_2$ is the SL period. According to the numerical and graphical analysis, there is a rather wide diapason of the SL properties (effective tensors μ, ε components and parameter x values) when the considered effect can take place.

The following possible applications of μ (ε) – isotropic SL are investigated:

i) devices with controlled electromagnetic waves transmission which can be selective on frequency;
ii) active elements of wide aperture light shutters;
iii) regimes of dynamic "switching on – switching off" the effective medium magnetic (dielectric) anisotropy at external controlling effects (at linear Faraday's effect or electro-optic effects).

## References

[1] I. V. Semchenko, Kristallografiya **35**, 3, pp. 1047-1050 (in Russian).