METHOD OF EIGENVECTORS FOR NUMERICAL STUDIES OF MULTILAYER GRATINGS

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A new method for numerical study of ideal multilayer gratings (MG) with rectangle grooves is developed. In this method electric field inside MG is regarded as series of special solutions to Helmholts equation — some "natural harmonics." The latter solutions are based on eigenvectors of transition matrix for etched bilayer. This matrix describes transformation of field vector — a vector composed of electric field Fourier components and their derivatives, — from the bottom surface of bilayer to its top surface. The natural harmonics are the convenient substitution to plane waves. Half of the harmonics correspond to eigenvalues with absolute value smaller than unity, the other half — to those with modulus greater than unity. The natural harmonics of the first type carry energy from the top of multilayer towards the substrate surface, those of the second type— in opposite direction. These two types of natural harmonics are treated different way in iterative procedure intended to reveal picture of diffraction. Approximation of the lowest order to diffracted field satisfies boundary conditions at the top of MG in assumption of infinite width of the grating. For such a grating field consists only of natural oscillations of the first type that are dying in depth of multilayer. Through boundary conditions at the bottom of multilayer their amplitudes yeld amplitudes of natural harmonics of the second type. Matching electric field above the grating to this the second type natural harmonics, one obtains correction to refracted field and some correction to incident field. The latter correction should be compensated since it distorts real picture of diffraction. Successive iterations results in its compensation.

This method works sufficiently well in many extreme situations where its ancestors fails. It can be applied even to study performance of MG in hard X-rays with grazing angles of radiation incidence. Some other applications of the method are under consideration.