# 14-Diffraction Physics and Optics



as a dynamic parameter even in a region where the Bragg law is not valid. This index of refraction is a straight-forward consequence of using the self-consistent mode of interaction developed between light, represented by EM field, and matter, by a set of vibrating dipoles. In this mode of scattering the EM field forces dipole oscillations, whose field must be accounted for as well as external field, composed of two waves, the incident and the reflected. The dipole contribution allows the energy of the system (considered without absorption) to be conserved.

Refraction and absorption are treated separately and appear as 'macroscopic' type phenomena in directions parallel to scattering planes of dipoles and as 'microscopic' phenomena in the direction normal to them. The last property is a direct result of the approach developed herein which treats the plane of dipoles as an EM plane wave transformer, altering in a steplike manner the amplitude and the phase of both interacting waves. The change in phase mentioned causes the direction of energy flow to be different from the direction of the actual wave vector which gives rise to the appropriate index of refraction, which in turn is different from the direction of either of the interacting waves. The second reflected wave, though it appears as a macroscopic entity only in some special cases, always has an important role in microscopic EM fields (evaluated at the dipole level).

The calculated values of index of refraction for Si single crystals within this model are smaller than unity for X-rays and larger than unity for light of longer wavelength. This result appears for both states of polarization and does not depend on absorption. In the intermediary region, for given charge density and radiation wavelength, some critical point can always be found for which the index of refraction is exactly equal to unity.

## PS-14.04.03 DYNAMICAL CALCULATIONS OF DIFFRACTION CONTRAST FROM MULTILAYER STRUCTURES AND CRYSTALS CONTAINING DEFECTS.

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Recent years have seen the extension of the conventional two-beam diffraction contrast technique to many-beam cases. In particular the combination of the technique of convergent beam electron diffraction (CBED) and real space imaging of multilayer materials and crystals containing defects has put a demand for an efficient and consistent framework for analyzing the experimental results obtained under many beam diffraction geometry. In this paper we will present a many-beam matrix formulation of dynamical theory of electron diffraction by multilayer materials and imperfect crystals, and its applications to the many interesting systems, such as the Si/GeSi strained layer superlattice and crystals containing stacking fault and dislocations. The theoretical results obtained have been compared with experimental observations, and excellent agreement has been achieved. Comparing with the existing algorithms, our matrix method is more flexible for different diffraction geometries and strain field distributions, and is at least an order of magnitude more efficient. Dynamical high-order Laue zone (HOLZ) effects are also most conveniently included.

## PS-14.04.04 THE EFFECT OF HIGHFREQUENCE ULTRASOUND ON THE DIFFRACTION OF THERMAL NEUTRONS IN BENT SILICON SINGLE CRYSTAL.BRAGG CASE.

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The influence of high-frequence ultrasounds on the reflection of neutrons with different wave lengths from bent silicon single crystals has been investigated.The frequency of ultrasound 30-150 MHz; neutron wave lengths 0,96A, 1,31A and 1,92A; radius of bending $R=5x10\text{-}5x10^4$ m.
The experiments were conducted by DIFRAN set up using time-of-flight methods.
The silicon sample with dimensions 6x60x120 $mm^3$ was bent by special arrangement. Simultaneously the intensity $I_s$ of two reflections 220 and 440 was measured.
Under certain $R\approx10^4$ m, the growth of $I_s$ with amplitude of ultrasound wave increasing was changed drastically to the decrease which reaches up to 50% from the primary $I_s$. The set of minima connected with phonons-neutron interaction was observed.
The results were explained by dynamic scattering theory developed recently for Laue case (E.M.Iolin, E.A.Raitman et al. Sov. Phys. JETP, 1988, 67, 989). It has been shown that high-frequency ultrasound violates the adiabatic motion of excited points on the sheetsRof the dispersion surface in slightly deformed single crystals. The good quantative agreement between theory and experiment was obtained. The possibilities of using of this effect will be discussed.

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