11.7-01 ФОТОЭМИССИЯ ПРИ ДИНАМИЧЕСКОМ РАССЕЯНИИ РЕНТГЕНОВСКИХ ЛУЧЕЙ В ИДЕАЛЬНЫХ И РЕАЛЬНЫХ КРИСТАЛЛАХ. <u>М.В.Круглов,</u> Ю.Г.Мясников. ВНИИ "Научприбор", Ленинград, СССР

Экспериментально и теоретически исследованы кривые угловых зависимостей выхода фотоэмиссии (ФК) при динамическом рассеянии рентгеновских лучей в совершенных кристаллах и в кристаллах с нарушенным в результате внешних воздействий (эпитаксия, имплантация ионов, и т.п.) приповерхностным слоем. При интерпретации ФК совершенного кристалла подчеркивается пропорциональность фотоэмиссии интенсивности рентгеновского волнового поля в местах локализации атомов, что позволяет непосредственно наблюдать эффект Бормана в случае Брэгга. При дифракции на кристалле конечной толщины демонстрируется более контрастное проявление эффекта "пенделлозунг" на ФК по сравнению с кривыми качания (КК). Показана высокая чувствительность ФК к хаотическим и направленным смещениям атомов из решеточных положений в приповерхностном слое, в том числе и в тех случаях, когда КК близки к КК совершенного кристалла.

11.7-02 THE DYNAMICAL DIFFRACTION DISPERSION SURFACE FOR CRYSTALS WITH SUPERLATTICE. By <u>I.R. Entin</u>, Institute of Solid State Physics, USSR Academy of Sciences, 142432 Chernogolovka, Moscow district, USSR.

The theory of the effects occuring with X-ray diffraction on a crystal with a periodic displacement field can be developed by two means. The first approach uses the theory of diffraction by a distorted crystal e.g. in terms of the Takagi equation system. Such technique is usually effective only for a one-dimensional geometry of the problem. Consideration of a crystal with a periodic displacement field as an ideal crystal with a modified translation symmetry is more general. The reciprocal lattice contains the satellites $\vec{H}+n\vec{K}_s$ as well as the principal points $\vec{H}$, where $\vec{K}_s$ - the superlattice vector. When $K_s \gg k|\chi_{\bar{H}}|$, where k- the wave number of incident radiation, $\chi_{\bar{H}}$ - the Fourier component of the polarizability, the problem can be reduced to a number of independent two-wave problems (R.Köhler et al. PSS (b) <u>61</u>, 439, 1974). If K_s and $k|\chi_{\bar{H}}|$ are the values of the same order the principal point and the satellites can be near the Ewald sphere simultaneously, and the problem does not reduce to the two-wave one. An analytic solution is obtained for a small amplitude of modulation. The result can be represented as a modified dispersion surface. As the length of a reciprocal lattice cell for a crystal with superlattice is equal to K_s, the dispersion surface represents in zero approximation a set of dispersion hyperbolae shifted by $\vec{K}_s$ relative to one another. The greatest changes of the eigenvalues occur in hyperbolic intersections, degeneracy connected with intersection being partially or completely lifted. With $\vec{K}_s \perp \vec{H}$ (Fig.1) self-intersection is possible when $K_s > |\Delta K_o|$ where $\Delta\vec{K}_o$-minimum splitting of the two-wave dispersion surface. With a weak modulation purely imaginary gaps occur in intersections. The degeneracy of the real parts of the wave vectors is lifted at a particular modulation level depending on the value $Im(\chi_{\bar{H}})$. When $\vec{K}_s \parallel \vec{H}$ (Fig.2) the degeneracy is lifted for any modulation level. The intersections correspond to superstructural reflections whose angular positions differ from the positions predicted on the basis of the kinematic theory. The imaginary part of the correction describes absorbtion and allows to explain the Borrmann effect resonant suppression.

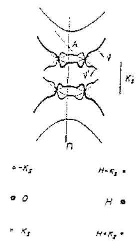

Fig.1

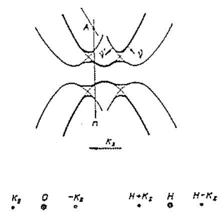

Fig.2

11.7-03 VIRTUAL BRAGG SCATTERING: A PRACTICAL SOLUTION OF THE PHASE PROBLEM. By L. D. Chapman, D. R. Yoder and <u>R. Colella</u>, Physics Department, Purdue University, W. Lafayette, Indiana 47907.

Multiple beam diffraction can in principle be used for phase determination because the relative phases of the various structure factors involved play a role in the measured intensities. We propose to make use of "Virtual Bragg Scattering", which is basically 2-beam diffraction with slight but measurable perturbations due to N-beam effects. The (222) reflection of silicon has been accurately measured with Cr-Kα (λ = 2.29 Å) in the symmetric Bragg case, for different values of the azimuthal angle ϕ which measures the rotation of the crystal around the scattering vector. A strong Umweganregung peak, the (222-1$\bar{1}$1-1$\bar{1}\bar{1}$), was examined in detail, and found to have a width $\Delta\phi$ of about 0.7°. <u>It was found that appreciable N-beam effects (2%) are detectable for ϕ-values 4° off the Umweganregung peak.</u> The mechanism responsible for such effects is inherently different from that operating on the tails of an ordinary 2-beam diffraction peak. It involves transitions that do not conserve energy. Hence the name of "Virtual Bragg Scattering". The measured perturbations around the (222-1$\bar{1}$1-1$\bar{1}\bar{1}$) Umweganregung peak are in perfect agreement with theoretical calculations. It is shown that changing the sign of one of the structure factors involved completely changes the expected ϕ-dependence of the N-beam perturbations around the Umweganregung peak. Phase information is therefore shown to be recoverable in this way. <u>We believe that this method can be applied to mosaic crystals, for which real phase problems exist.</u> In fact, given the conditions under which the present experiment is done, the global interaction between x-rays and crystal is very weak. The probability of multiple scattering is small, and in such a situation dynamical and kinematical theories predict the same integrated intensities.