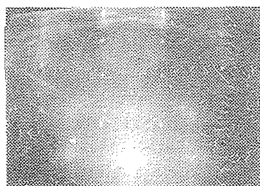

Fig.1 RHEED pattern from Si(111)7x7-H in the [11$\bar{2}$] direction of the incidence.

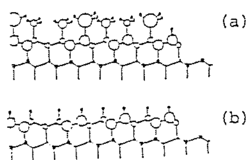

Fig.2 Side views of Si(111) 7x7-H surface models. (a) SiH_3 at random on-top sites. (b) H at the on-top sites.

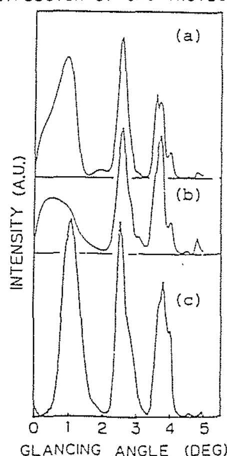

Fig.3 00-rod rocking curves. (a) 5-beam calculation for the model(a). (b) The calculation for the model(b). (c) Experimental curve.

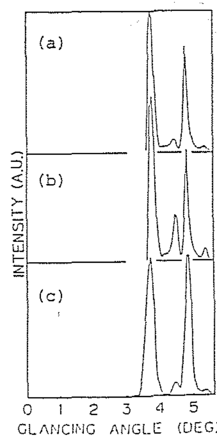

Fig.4 11-rod rocking curves. (a) 5-beam calculation for the model(a). (b) The calculation for the model(b). (c) Experimental curve.

14.X-7 EXPLOITING DYNAMICAL HIGH ENERGY ELECTRON DIFFRACTION EFFECTS. By C.J. Humphreys and D.J. Eaglesham, Department of Materials Science and Engineering, University of Liverpool, P.O. Box 147, Liverpool, L69 3BX, U.K.

By exploiting dynamical high energy electron diffraction effects we can gain new insights into the structure of materials on an atomic scale. For example, conventional methods of microanalysis (e.g. Auger, EDX) often do not have the spatial resolution required for measuring composition changes in, say, quantum well structures. Microanalysis may, however, be performed using convergent beam electron diffraction (CBED) with a spatial resolution of the incident beam probe diameter, broadened only by elastic beam spreading (Eaglesham and Humphreys, Proc. XIth Int. Cong. on Electron Microscopy, Kyoto, 1986, 209). This technique utilises the fact that different fast electron Bloch wave states in a crystal are localised on different atomic strings (i.e. columns of atoms) for appropriate orientations of the incident electron beam. The wave vectors of these Bloch waves appear as different lines in higher order Laue zones of CBED patterns. Hence the separations of the lines are a direct measure of the potential of the atom strings, and hence the composition.

Similar exploitation of dynamical diffraction is utilised in ALCHEMI (Spence and Tafto) for atomic site location, the critical voltage effect for electron bonding location, and two-dimensional critical voltage effects for structure determination (Steeds and Vincent).

14.X-8 IMAGE DECONVOLUTION FOR PERFECT CRYSTAL IMAGES. By F.H.Li, Institute of Physics, Academia Sinica, Beijing, China.

High resolution electron microscopy is useful for determining structures of minute crystals. The disadvantage is in the close dependence of image contrast on defocus condition and specimen thickness. Even for weak phase objects the image intensity is expressed as a convolution of projected potential distribution function(PPDF) with the Fourier transform of contrast transfer function. To combine images from a through focus series is valid to obtain the so-called deconvoluted image where the phase shift of diffracted waves caused by the contrast transfer function is compensated (D.L.Misell and P.A.Child, J. Phys. D., 1972, 5, 1760; E.J.Kirkland and B.M.Siegel, Ultramicroscopy, 1984, 15, 151; E.J.Kirkland, B.M.Siegel, N.Uyeda and Y.Fujiyoshi, Ultramicroscopy, 1985, 17, 87; W.O.Saxton, Proc. 11th Intern. Congr. on Electron Microscopy, 1986, Post deadline paper one). For some specimens, especially most of organic materials, it is not allowed to record enough images with different defocus values for image deconvolution. Another problem is to tell the structure image from a series of micrographs taken under different imaging condition when the average structure of the examined crystal is still under determination. Hence, it is of interest to study how to restore the intuitive structure information from a single image of any defocus condition(N.Uyeda and K.Ishizuka, Proc. 8th Intern. Congr. on Electron Microscopy, 1974, Vol.1, 322; F.H.Li and H.F.Fan, Acta Physica Sinica, 1979, 23, 276). It has been shown that for weak phase objects the image deconvolution can be made by use of the direct method well developed in X-ray crystallography on the basis of a combination of informations contained in a single electron micrograph and its corresponding electron diffraction pattern(F.S.Han, H.F.Fan and F.H.Li, Acta Cryst., 1986, A42, 353). In practice, crystal examined under a high resolution electron microscope are thicker than a weak phase object and generally can be treated as a pseudo weak phase object(F.H.Li and D.Tang, Acta Cryst., 1985, A41, 376). Its image intensity at the optimum defocus condition would be linear to a modified projected potential distribution function(MPPDF) depending upon the crystal thickness. Below a critical crystal thickness which depends on the heaviest atoms in the crystal and the electron wave length the MPPDF has its peaks at the same position as the PPDF and peak hights monotonically relate to those of the PPDF. Above the critical thickness the MPPDF would have negative peaks at the position of relative heavier atoms so that it would be no more similar to the PPDF(F.H.Li and D.Tang, Acta Cryst., A41, 376). This gives a possibility of reconstructing an image of any defocus value for pseudo weak phase objects to the optimum defocus one. A method of image deconvolution based on a single electron micrograph and its corresponding electron diffraction pattern has been proposed. The test result for simulated images of chlorinated-copper phthalocyanine with different crystal thickness and different defocus value is shown(D.Tang and F.H.Li, to be published).