14.4-18 SYSTEMATIC HRTEM IMAGING OF TETRAHEDRAL SEMICONDUCTORS. By R.W. Glaisher[1,2], David J. Smith[2] and A.E.C. Spargo[1], School of Physics, University of Melbourne, Victoria, 3052, Australia (1) and Department of Physics, Arizona State University, Tempe, AZ 85287, U.S.A. (2).

The characterisation of the structure of tetrahedral semiconductor crystals, and particularly the identification and refinement of defect structures, in high resolution TEM studies is hindered by the complexity of the images, even for perfect crystals, and the sensitivity of them to several critical experimental parameters. Techniques have now been devised to determine these parameters to adequate precision either by the deliberate use of low resolution images combined with a suitable choice of accelerating voltage or by imaging at the highest currently attainable resolution where the non-linear scattering and interference effects that contribute to the fine detail in the image (in the perfect crystal regions) can be exploited. Experimental studies on Si and Ge at 100 kV and 400 kV have confirmed this approach. For the binary compound semiconductors, having either the sphalerite or wurtzite structure, an important step for atomic level image interpretation is the identification of the absolute direction of the polar axis. That this can be done by direct observations on characteristics in the images (both high and low resolution) of perfect crystal regions has been investigated experimentally using InAs and CdSe crystals.

14.4-19 DYNAMICAL DIFFRACTION EFFECT ON HIGH RESOLUTION ELECTRON MICROSCOPY OF ALLOYS WITH IMPERFECT ORDER. BY D. Shindo, K. Hiraga and M. Hirabayashi, The Research Institute for Iron, Steel and Other Metals, Tohoku University, Sendai, Japan.

In this paper, we discuss the characteristic dynamical diffraction effect on the atomic scale images of ordered alloys observed by many-beam electron microscopy. In an imperfectly ordered alloy, the dynamical effect on the scattering amplitude of a superlattice reflection $\Psi_t(H+h)$ at the crystal thickness t can be presented with "dynamical factor" $D_t(H+h)$ in the relation

$$\Psi_t(H+h) = G(h)\, F(H+h)\, D_t(H+h),$$

where G(h) is the geometrically defined structure factor and F(H+h) is the difference of the scattering factors of constituent atoms for the superlattice reflection H+h. Thus G(h)·F(H+h) corresponds to the kinematical scattering amplitude of the superlattice reflection. This relation holds under the conditions

$$|\Psi(H)| > |\Psi(h)|, \text{ and } G(h) = G(H+h),$$

where $\Psi(H)$ is the scattering amplitude of the fundamental reflection H. The dynamical factor $D_t(H+h)$ does not directly depend on G(h), and so that it can be evaluated without postulating any ordered atomic arrangement as far as the alloy composition is known. With calculation of D_t as functions of H+h and t for some alloy systems, it was shown that the dynamical factor tends to take a constant value for h (H=0) even in a rather thick crystal of the alloy of which F(H+h) is small. Thus if the optimum conditions of defocus and aberrations are satisfied, the high resolution images of such alloys with imperfect order may be interpreted kinematically in terms of the projection of the imperfectly ordered atomic arrangements as in the case of perfectly ordered alloys (D. Shindo, Acta Cryst., 1982, A38, 310-317).