

## **A REVIEW OF CONVERGENT-BEAM ELECTRON DIFFRACTION (CBED).**

Alwyn Eades  
Department of Materials Science and Engineering  
Lehigh University, Bethlehem, PA 18015-3195

At the energies used in transmission electron microscopy, the wavelength of the electrons is much smaller than typical lattice spacings, so that the Bragg angles are very small, on the order of a degree. The interaction of electrons with solids is so strong that, in the case of electron diffraction from crystalline samples, the diffraction is almost always strongly dynamical, and the rocking curves are very broad, on the order of a degree for low-index reflections.

As a result of this combination of circumstances, a map of the variation of intensity in the direct and diffracted beams shows highly complex patterns. This is revealed experimentally in the technique called convergent-beam diffraction. The strong dynamical diffraction is both the curse and the blessing of the method. The curse because any detailed interpretation of the diffraction patterns requires complex simulation. The blessing because the very complexity of the patterns provides a richness of information that would not be available in other experiments. It is also important, in many cases, that the information obtained from convergent-beam diffraction characterizes a very small volume of the sample (10 x 10 x 100 nm, say).

There are many kinds of information that may be extracted from convergent-beam patterns. The established techniques largely depend on simple observation of the patterns whereas newer techniques involve quantitative simulation of the patterns.

Convergent-beam diffraction:

- Provides direct observation of the reciprocal lattice
- Permits measurement of local variation of lattice parameter
- Identifies the symmetry of the crystal structure
- Identifies phases
- Gives a new method of characterizing defects (dislocations)
- Allows the thickness of the sample to be determined
- Can determine the atomic coordinates
- Can determine the bonding charge density.

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