HIGH RESOLUTION TRANSMISSION ELECTRON MICROSCOPY (HRTEM)

HRTEM can provide structural information at better than 0.2 nm spatial resolution.[1] In most crystalline inorganic materials, including ceramics, semiconductors, and metals, the positions of individual atomic columns can be resolved, at least in low-index zones.[2] When recorded under optimum conditions, electron micrographs can be directly interpreted in terms of the projected crystal potential. In other cases, image simulations are necessary to match proposed structures to image features.[3] Digital image recording and quantification of diffraction pattern intensities is possible with the extreme linearity and high DQE of a CCD camera.[4] Dynamic events induced by the electron beam or indirectly with a heating holder can be followed by video-tape recording from a TV-rate image pick-up system.[5] At lower resolution, amplitude contrast images can be used to observe material features in the 1µm-0.5nm range.[6]

Possible Applications

- distribution and structure of defects, interfaces and grain boundaries
- nano-crystalline features in amorphous films
- small particle analysis in heterogeneous catalysts
- sub-micron morphological and device features
- thermodynamic decomposition, diffusion, and phase transformations

Specimen Requirements

For highest resolution, specimens must be <10nm thick. In general, specimens prepared by chemical thinning, crushing, or ion beam milling will contain suitable regions.

Limitations

High magnification imaging requires a high electron dose, so specimens need to be relatively beam insensitive. The technique, by itself, provides very limited chemical information. Heating experiments must be designed to minimize contamination of the microscope.

Suitable Microscopes

This technique is available on the following instruments:

- FEI Tecnai F20
- JEOL JEM 2000FX

- JEOL JEM 2010F
- JEOL JEM 4000EX
- Philips CM200-FEG
- Topcon 002B

References

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