Transmission electron microscope (TEM)
Similarity in design between (a) an optical microscope and (b) a transmission electron microscope.
Interaction between the electron beam and the materials
Formation of the diffraction pattern and the image in the TEM
Electron diffraction pattern
Precipitates formed in an Al alloy (a) bright field image; (b) diffraction pattern from the area in (a).
Precipitates formed in a spray-formed IN 718 aged at 750°C for 24h; TEM, (4918)
High resolution images formed in the TEM.
Figure 4.22 Dislocations in strong diffraction contrast in a metal foil.
Scanning electron microscope
Schematic diagram showing the main component of a scanning electron microscope
SEM advantages

1. Resolution
2. Depth of focus
3. Chemical analysis
Beam – specimen interaction 20kV

- Primary electron beam
- Source of secondary electrons
- Source of backscattered electrons
- Source of electron-excited characteristic X-rays

Sample

1 μm
Monte Carlo simulation of electron trajectories in iron as a function of accelerating voltage.
SEI – Surface detail provided by only the secondary electrons that can escape from near the surface of the sample.

Secondary electron image
(topographic image)

BSE – Z (atomic number) contrast is provided by electrons that “backscatter” in the direction of the incident beam.

Backscattered electron image
(compositional image)
BSE – atomic number contrast

Oxidised silicon nitride

Y rich
Secondary electron image (SEI) and the X-ray energy dispersive spectrum (XEDS) obtained from the arrowed particle.
Compositional maps (or X-ray images)