INTERNATIONAL ATOMIC ENERGY AGENCY
UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION

INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS
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SMR/388- 14

SPRING COLLEGE IN MATERIALS SCIENCE ON 'CERAMICS AND COMPOSITE MATERIALS' (17 April - 26 May 1989)

ELECTRON, MICROSCOPY (transmission, scanning, Auger) [Slides and Overheads]

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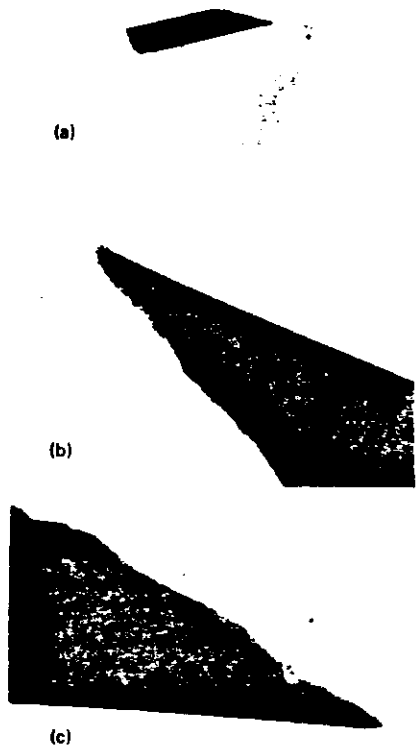
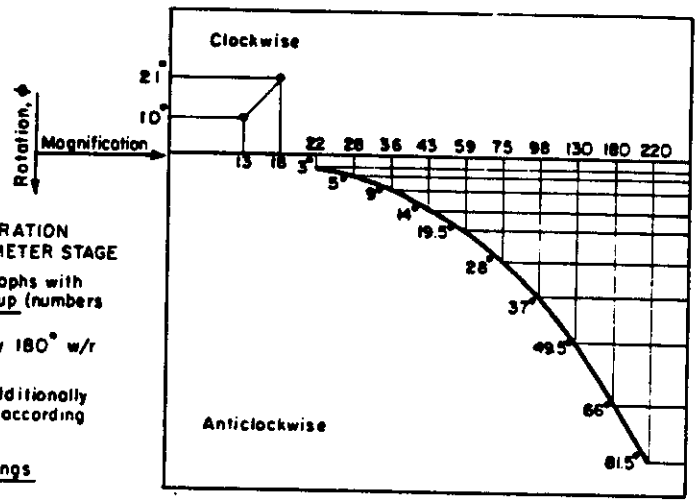
United Kingdom

5/2a



The image inversions of a MoO_3 single crystal, taken with a Philips EM 301 equipped with a high resolution stage: (*a*) low magnification (×1300–×6000), (*b*) intermediate magnification (×7250–×3000) and (*c*) high magnification (×36,000–×360,000).

5/4a



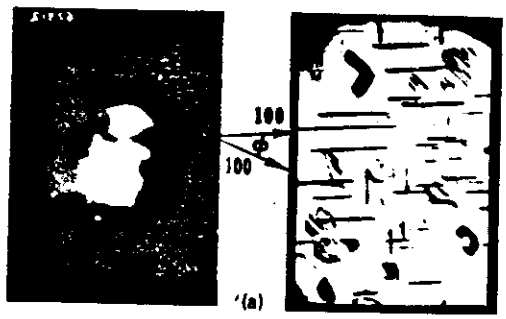
ROTATION CALIBRATION
PHILLIPS GONIOMETER STAGE

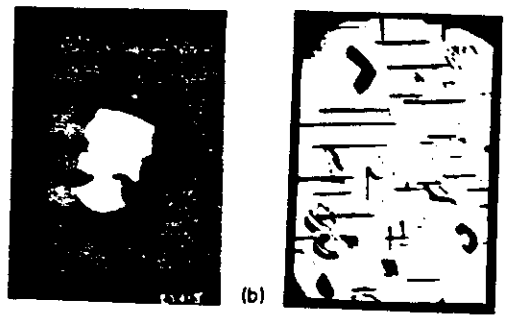
1) Place micrographs with emulsion side up (numbers reversed)
2) Rotate SAD by 180° w/r to image
3) Rotate SAD additionally by ϕ degrees according to graph

Lens Settings

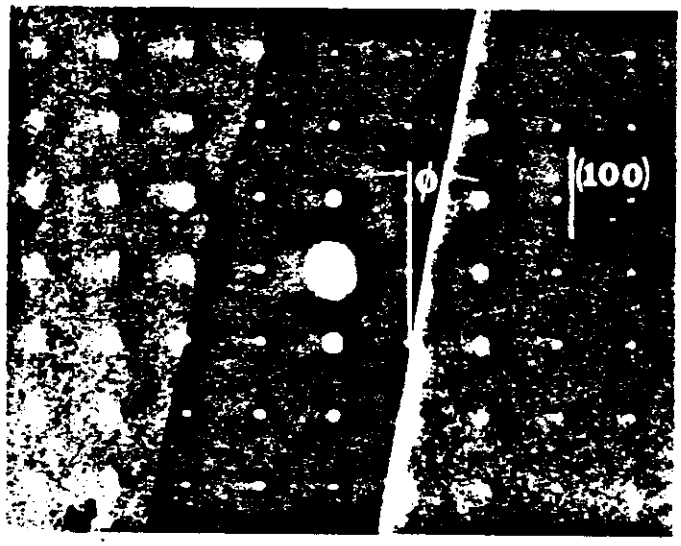
Proj: 3.01
Int. : 0.67 (coarse control: 3, fine control: clockwise)
Diff: 1.62

The rotation calibration of a Philips EM 301 electron microscope equipped with a goniometer stage.

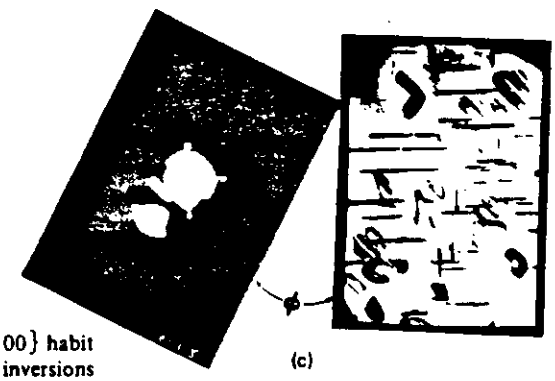




5/3

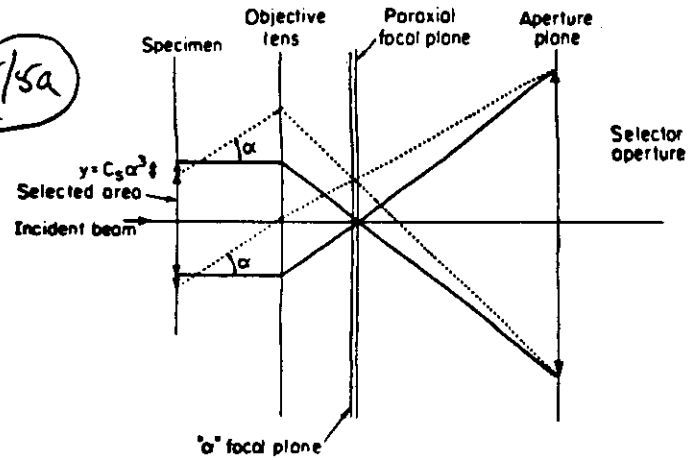


Single crystal of MoO_3 with its selected area diffraction pattern superimposed (100 kV). The rotation ϕ (≈ 11°) is the angle between the edge of the crystal and the [100] row of spots (×7750).



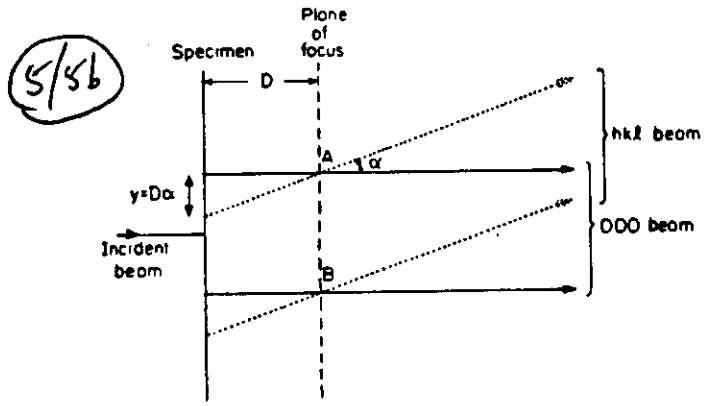
An Al-4wt% Cu alloy aged to produce θ' precipitates (exhibiting {100} habit planes) illustrates the procedure to correctly account for electron microscope inversions and rotations. (*a*) EM negatives are placed emulsion side up. Notice the angle ϕ between [100] in the image and diffraction pattern. (*b*) The diffraction pattern is rotated 180°. (*c*) The diffraction pattern is rotated a further ϕ degrees. The rotation in this case is ~23°, which is the angle between the trace of the θ' on (100) in the image and the corresponding 200 diffraction spot in the diffraction pattern. (Siemens Elmiskop IA operating at 100 kV and at an magnification of ×14,000.) Mark, in ink, the direction of the diffraction vector on the nonemulsion side of the EM image. Notice the positions of the identification numbers

5/4b



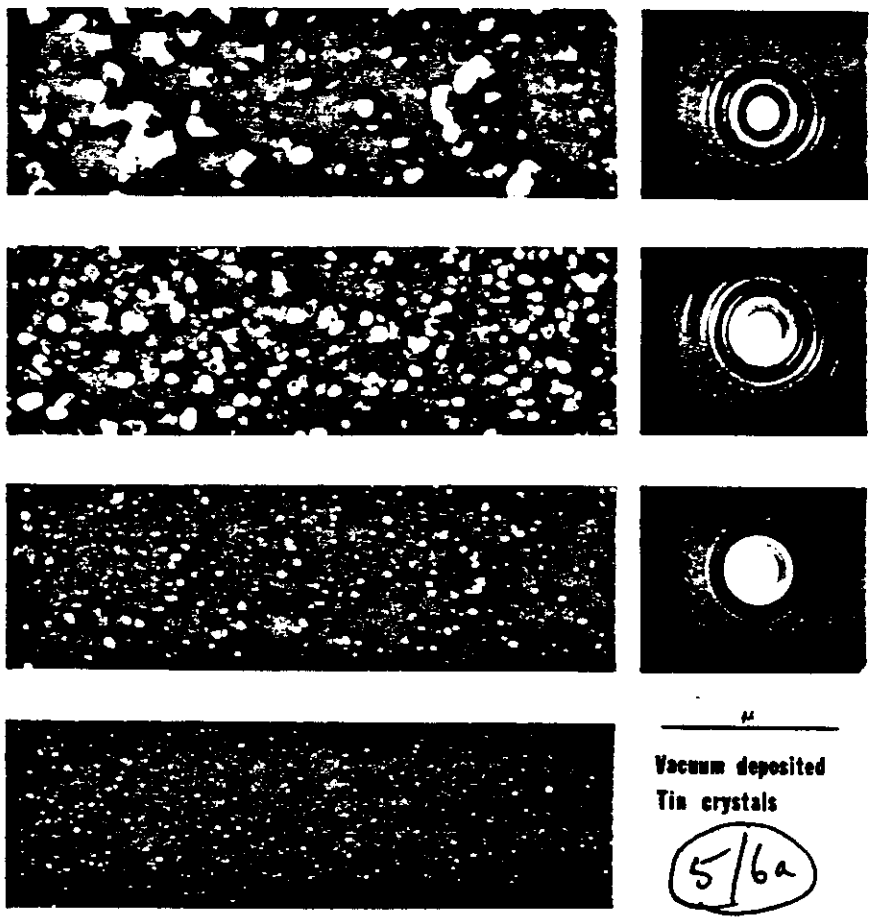
5/5a

Formation of the first intermediate image by the objective lens, illustrating the effects of spherical aberration.



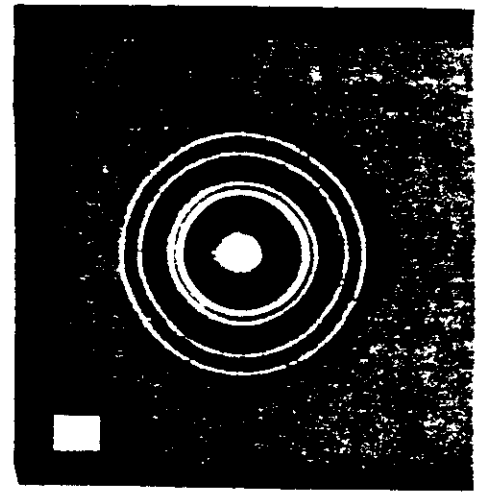
5/5b

Illustrating errors in selected area diffraction arising from incorrect focusing.

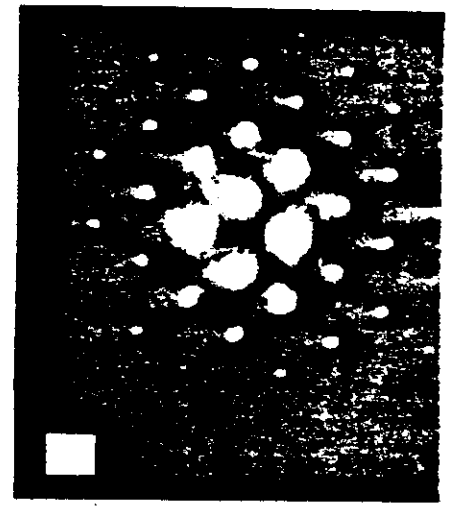


5/6a

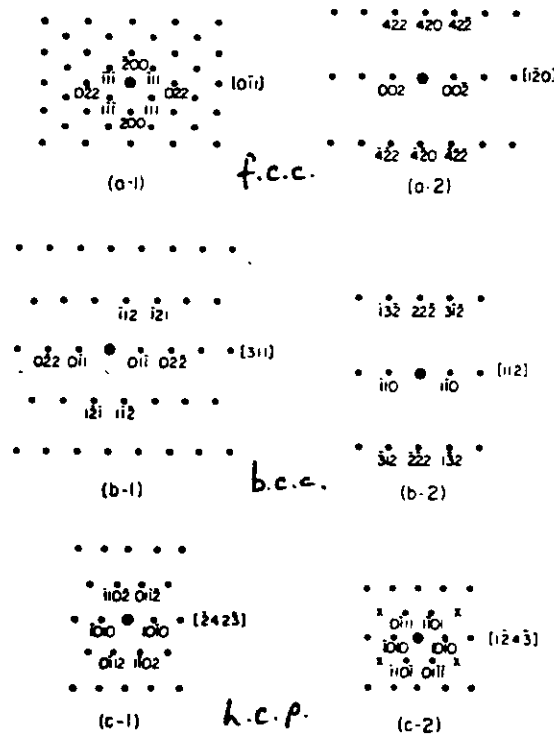
Dark field images and ring patterns from vacuum-evaporated tin, showing change in grain size. Arcing of rings indicates preferred orientation. Courtesy W. L. Bell.



5/5c Powder ring pattern

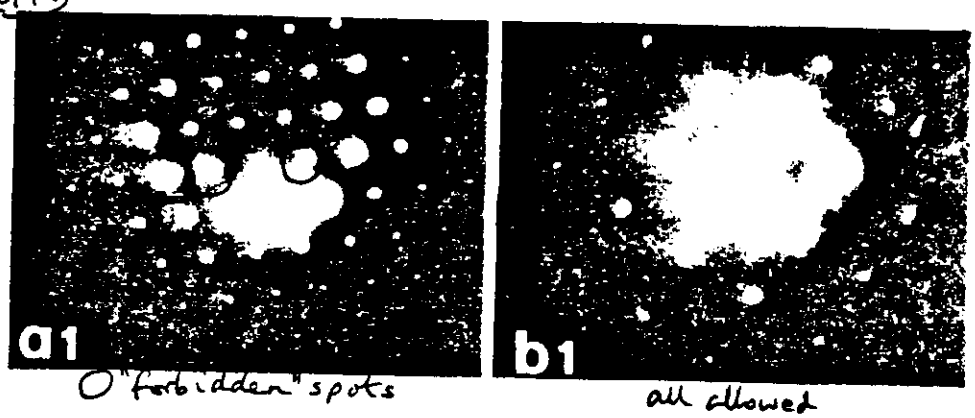


5/6b Single Crystal pattern



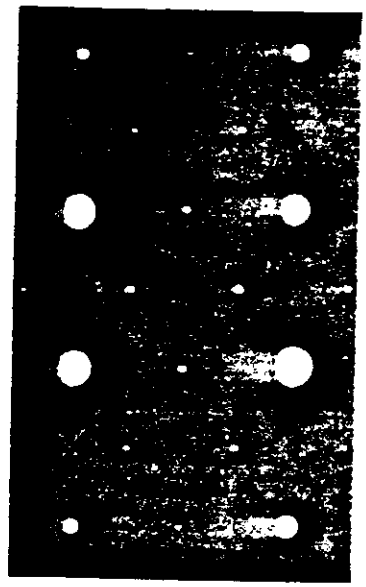
5/7 Some indexed single crystal patterns. Beam

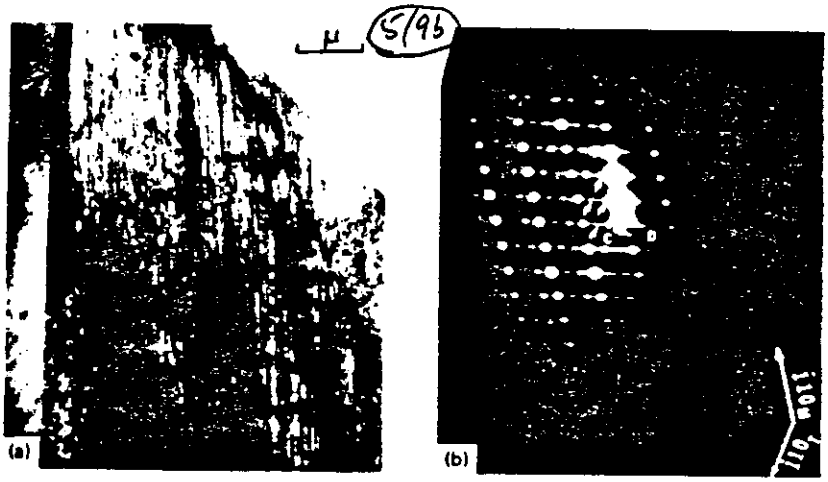
5/9a



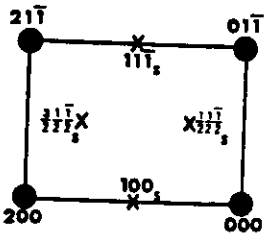
O "forbidden" spots

all allowed



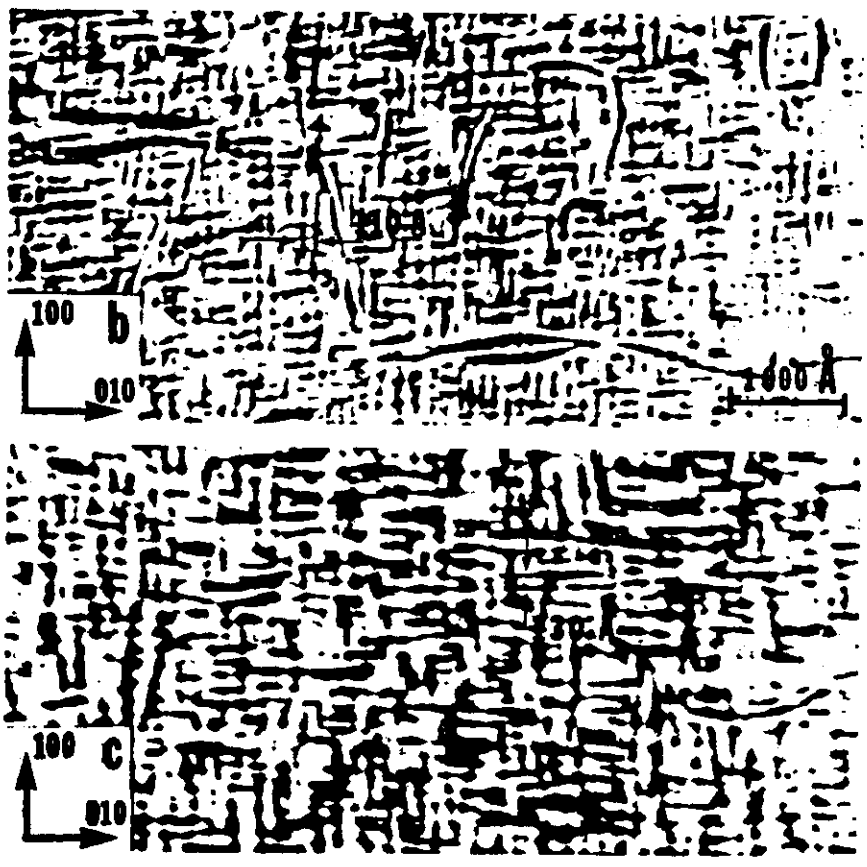


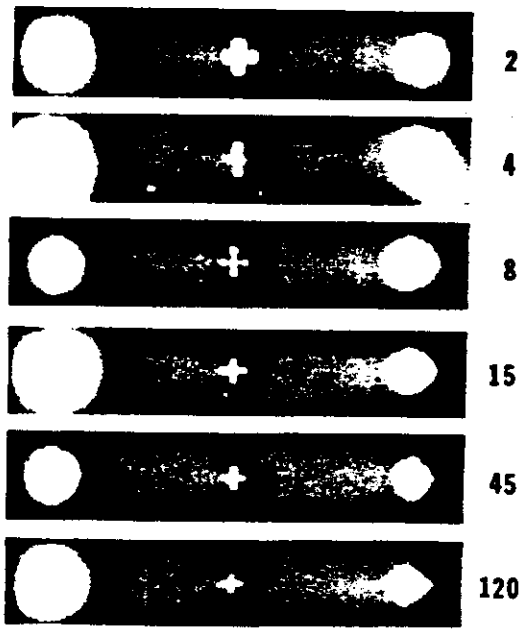
5/9b



5/11a Pattern from an ordered structure.

(*a*) Bright field image. (*b*) Diffraction pattern showing {112} transformation twinning in Fe-32% Ni martensite. The $\bar{1}\bar{1}3$ primary twin spot pattern superimposes on the [113] matrix; double diffraction spots are arrowed.

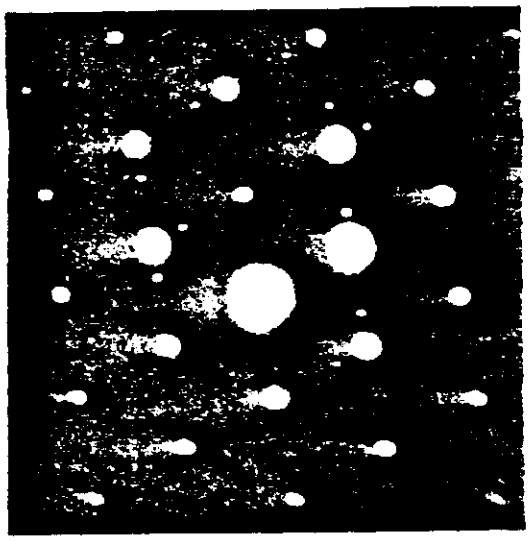


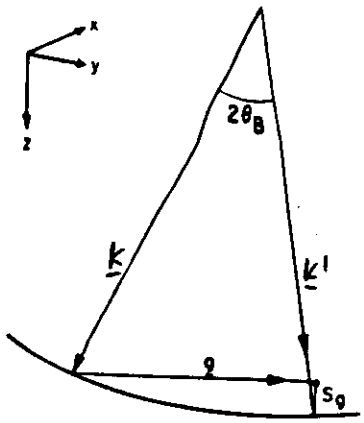


5/10b Diffraction patterns from spinodal structure as at left.

5/10a

(*a–c*) Bright field images of spinodal microstructure of $Cu_{2.2}Mn_{0.8}Al$, showing coarsening of the wavelength with aging at 350°C for (*a*) 30 sec, (*b*) 1 min, (*c*) 2 min. g = 220.

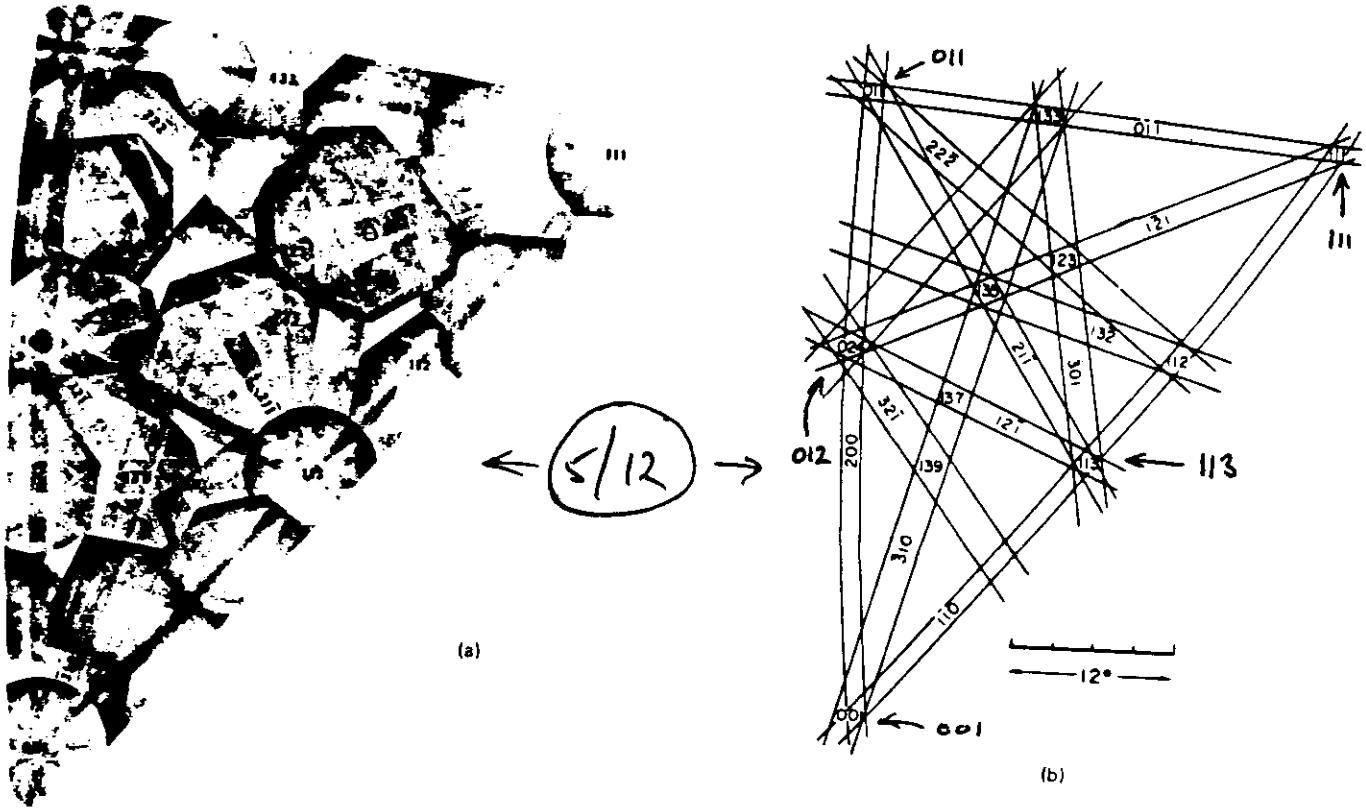




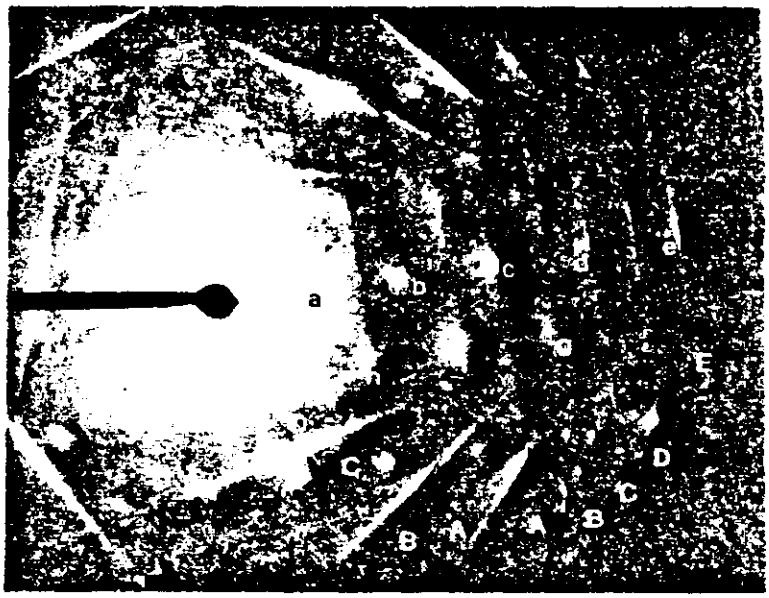
5/13a

The Ewald sphere construction, relating incident wave of wave vector $\underline{k}$ diffracted wave $\underline{k}'$ reflecting vector **g**, and deviation parameter s_g.

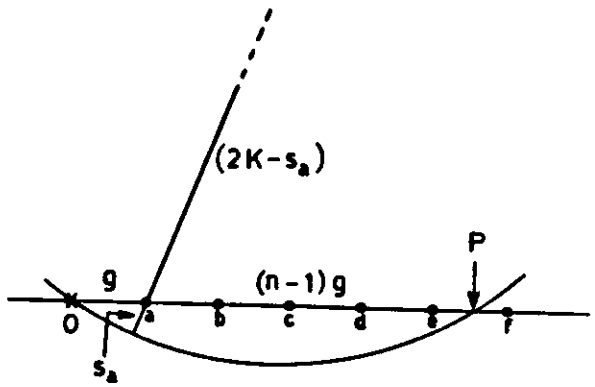
5/11b Faint spots by double diffraction from fcc twinned structure.



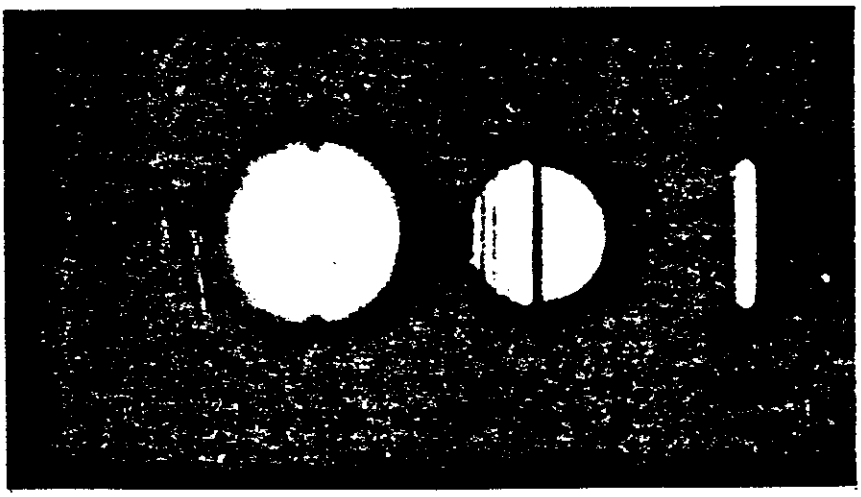
(*a*) Composite Kukuchi map for bcc crystal. (*b*) Indexing and scale factor. Courtesy *Journal of Applied Physics*.[27]



5/14a Spots + Kikuchi Lines, Si



5/14b Analysis for measuring s_a (deviation parameter)



A convergent beam diffraction pattern from a copper specimen at 200°C.

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