PHYSICS OF MATERIALS

Physics School Autumn 2025

Series 10 Solutions **28 November 2025**

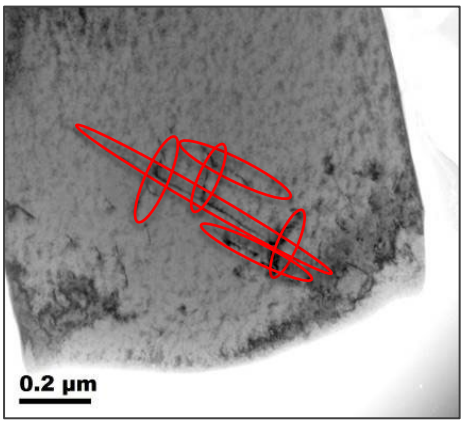
Exercise 1: Dislocation Analysis

a)

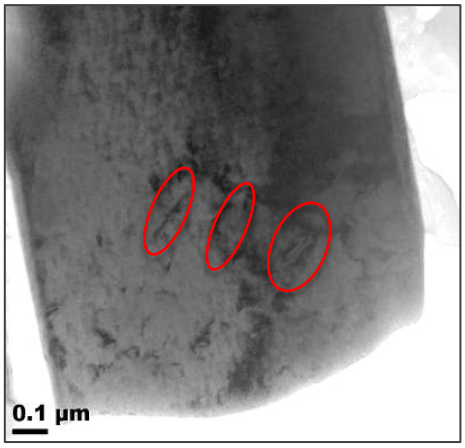
Diffraction contrast is a form of amplitude contrast arising from the electron beam scattering in the sample at defined Bragg angles. A strong 2-beam condition is set up by tilting a sample such that a diffraction condition on a specific g-vector and the Ewald's sphere cuts through the reflection rod at s=0. Under these conditions, the intensity is strongly affected by any distortion of the atomic planes of the excited g-vectors. These areas appear bright in dark-field images and dark in bright-field images.

b)

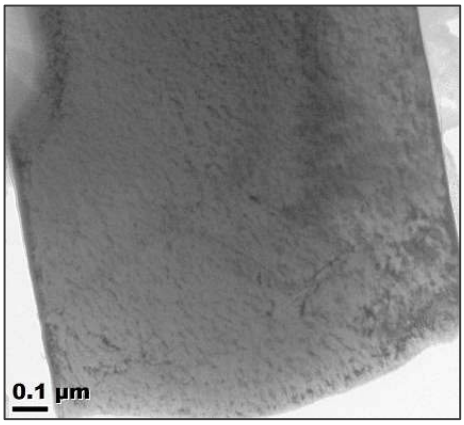
I indicated some dislocations by circling them in the images in red. Please note that in the lower-left image, all dislocations are invisible.



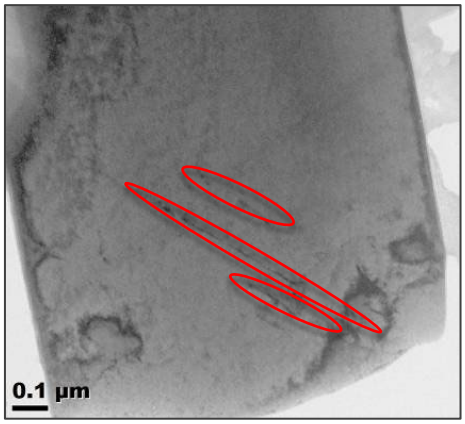
g_1=[1 0 3^{-}]



g_2=[1 2 3]



g_3=[1 1 2]

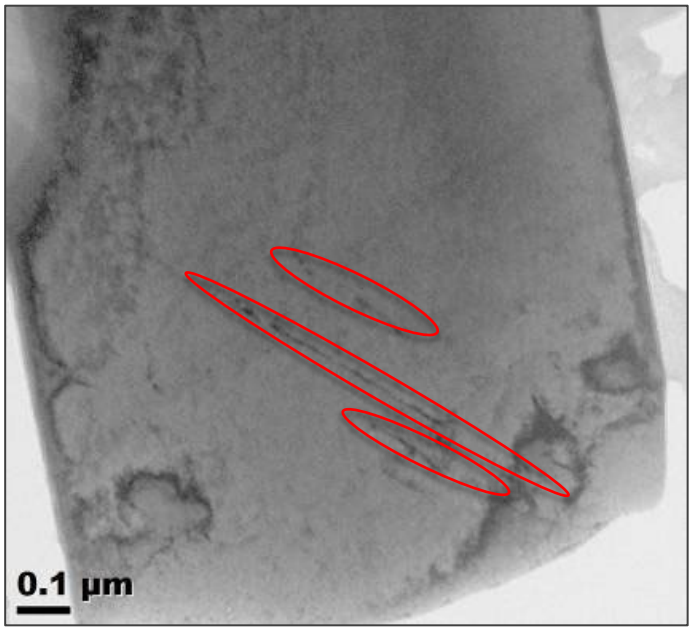


g_4=[1 2 3^{-}]

c)

Since the curvature of atomic planes arises from the local elastic strain field of a dislocation with a given Burgers vector, contrast is governed by the amplitude of the diffracted signal along a *g*-vector. The invisibility criteria, i.e., no contrast in conditions where $g \cdot b = 0$ for screw dislocations and $g \cdot b \Lambda \vec{\xi} = 0$ for edge dislocations.

d) Identify this possible Burgers vector, assuming that this is a screw dislocation which has a Burgers vector of type: b=a_0/2 ⟨1 1 1⟩



g4=[1 2 $\bar{3}$]