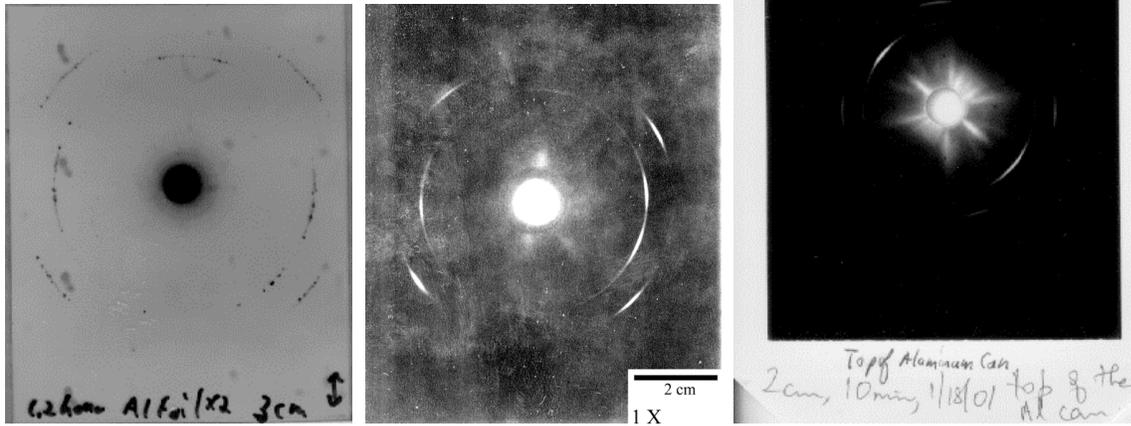


## Homework 4 Properties of Materials

- 1) Aluminum displays an FCC crystal structure.
  - a) Sketch the FCC structure showing the (111) plane and the [110] direction.
  - b) Why are this plane and this direction important to deformation of aluminum?
  - c) What evidence exists that FCC crystals do not deform by motion of an entire plane of atoms?
  - d) Show how a disclination and an interstitial impurity can interact.
  - e) List the types of crystalline defects that can be involved in deformation of metals and ceramics.
  
- 2) Most metals that are encountered in everyday life are composed of grains.
  - a) What is a grain and how do grains form when a metal crystallizes from the melt?
  - b) How does the yield stress scale with grain size?
  - c) Explain the following three diffraction patterns in terms of the structure of the grains in aluminum.



- d) Explain how a grain boundary interacts with motion of disclinations.
  - e) When metals approach their failure stress they can often be heard to creak as twinning occurs. Explain what is meant by twinning.
  
- 3)
  - a) Sketch engineering stress versus engineering strain for copper showing the yield point and failure stress.
  - b) Using the sketch of part a show how strain hardening occurs (pick several paths of strain hardening in the sketch of part a and explain differences in the mechanical properties when the stress is relieved.)
  - c) Show how the yield stress depends on the disclination density.
  - d), e) Describe two metal shaping operations that involve strain hardening.