

Problem M15

Give short answers (3-5 sentences) to the following questions. This material may not be covered in lectures. Ashby and Jones Ch. 8-15 will be a useful resource.

- a) Explain briefly what is meant by a “dislocation” and explain with an appropriate diagram how edge dislocations can contribute to yield and plastic deformation of a material.
- b) Why are the skins of aerospace structures often made by a hot rolling process, followed by a cold rolling process? I.e. the initial reduction in thickness from a billet (large ingot) of material is performed at elevated temperatures, but the final steps in thickness reduction are performed at room temperature?
- c) Explain why a single crystal of a metal or alloy is usually softer (lower yield strength) than a polycrystalline specimen of a metal.
- d) Why are higher yield strength metal alloys usually more brittle than lower yield strength alloys?
- e) Why do carbon fibers or glass-fibers have such high strengths compared to the bulk materials (graphite and glass)?
- f) Explain this observation. The first aerospace aluminum alloy (Duralumin) was found to have a hardness that depends on the length of time that it is exposed to an elevated temperature. Initially the hardness increases with exposure time until it reaches a maximum value, after which the hardness decreases with additional elevated temperature exposure.