

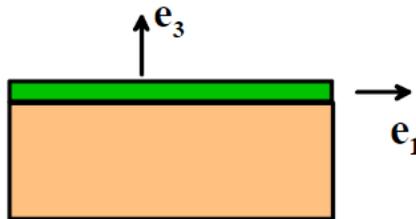
ED 3160, Quiz #2 , Oct 20 2010

Instructions

1. If something is not clear, come up and ask in a soft voice; do **not** discuss amongst yourselves.
2. Time limit is 50 minutes.
3. Cheating of any sort will not be tolerated; you will receive zero credit and may face additional consequences.

Questions

1. A 50mm diameter forging billet is decreased in height from 125 to 50 mm.
 - (a) Determine the average engineering strain and true strain in the axial direction.
 - (b) What is the final diameter of the forging (neglect bulging)? **(3)**
 - (c) What are the transverse plastic strains?
2. An isotropic, homogeneous, linear-elastic thin film is bonded rigidly to a much larger substrate. The Young's modulus, Poisson's ratio, yield stress in tension and coefficient of thermal expansion of the film are E, ν, σ_0 and α respectively. The film can be assumed to be stress free at room temperature. If the film and substrate are then heated up, derive an expression for the temperature at which yield occurs using a) the von Mises criterion and b) Tresca criterion. State assumptions, if any, clearly. **(3)**



3. A material is tested under the state of stress $3\sigma_1 = \sigma_2 = -2\sigma_3$. If yielding is observed when $\sigma_2 = 140$ MPa, what is the yield stress in pure shear according to the Tresca criterion? **(2)**
4. Derive the slip system for a simple cubic crystal lattice. Sketch a slip plane and a slip direction on a unit cell. What is the Burgers vector for this lattice? **(3)**
5. What is the difference between resolved shear stress and critical resolved shear stress? What is the Schmid rule for a single crystal? Derive the relevant mathematical statement. **(2)**
6. Why are HCP metals brittle compared to FCC and BCC metals? Why do BCC metals have a higher critical resolved shear stress compared to FCC and BCC metals? **(2)**