

Take Home Exam02A: Plasticity-Intro

Assigned: Sunday 02/13/2022

Due (as pdf by email) 02/16/2022 (within three working days)

You may submit your answers in one of two ways:

1) For typed answers: as a .docx file (as is) or converted into a pdf file. (DO NOT SEND GOOGLE DOC)

For handwritten answers: Please scan as images, and group together into one pdf file. Or you may hand them manually to my office (ECME-212)

HW 02A.1

Define the two components of a slip-system: (i) the slip plane, and (ii) the slip direction.

Why are these two vectors orthogonal to one another (remember that the plane is defined by a vector that is normal to the plane)?

HW 02A.2

In a uniaxial test the orientation of the slip-system is defined by two angles:

- (i) The angle between the uniaxial axis and the plane normal, given by λ ,
- and (ii) The angle between the uniaxial axis and the slip vector, given by ϕ .

If σ_1 is the uniaxial stress applied to the crystal then show that the shear stress acting on the slip system (also called the critical resolved shear stress) will be given by:

$$\tau_{CRSS} = \sigma_1 \cos \lambda \cos \phi$$

HW 02A.3

The tensile strength of single crystal "whiskers" of iron varies with their diameter as shown on the right.

What is the physical significance (the mechanism?) of the strength rising quickly when the diameter approaches approximately $1 \mu\text{m}$?

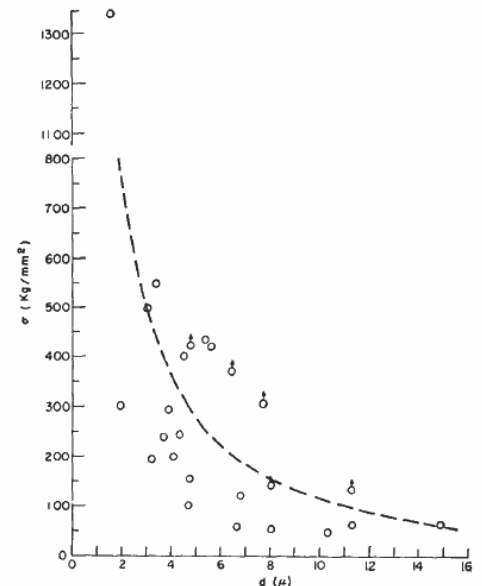


FIG. 6. The effect of size on the strength of iron whiskers. δ fracture occurred at or near grips. True fracture stress may have been higher.