03/29/2021

HW15: Fracture: Work of fracture measurement with a double cantilever beam specimen

Overview

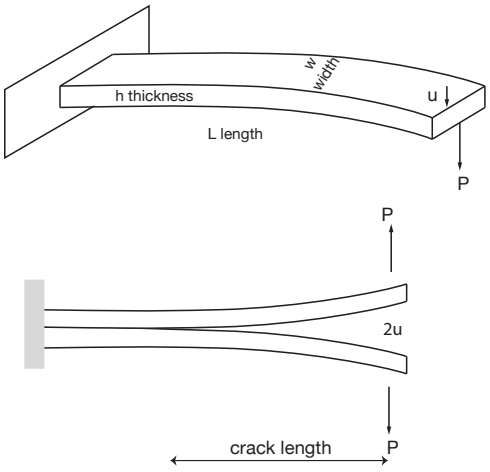
In this HW you are asked to calculate the load that would be required to cause fracture in a specimen made of silicon with a variable fracture energy using the equation derived in class that is

$$2\gamma_F = \frac{P^2}{2w}\frac{dS}{dc} \qquad (1)$$

where P is the load at fracdture, w is the depth of the double cantilever beam (DCB) specimen.

(i) Please show that the units in Eq. (1) are balanced.

The geometrical parameters for the specimen are given below



$$u = \frac{PL^3}{3EI},\ I = \frac{wh^3}{12} \qquad k = \frac{P}{2u},\ S = \frac{2u}{P}$$

In above k is the stiffness and S is the compliance (equal to the inverse of the stiffness)

You may use the following geometrical parameters (referring to a specimen made with MEMS technology)

L, the crack length = 200 μm

h, the thickness = 25 μm

w, the width =50 μm

Assume that the work of fracture for silicon, varies between 2 to 10 J m^{-2}.

(ii) Make a plot of the Load at fracture (P) as a function of $2\gamma_F$.

(iii) Draw a second curve in the same plot using the crack length to be 150 μm (instead of 200 μm)