Take Home Exam04A: Tensile test for Superplastic Deformation

Assigned: 04/14/2022 (Thursday)

Due (as pdf by email) 04/19/2022 (Tuesday)

(ii) Please send your submission via email starting with HWExam04A in the subject line.

04A.1

A tensile test is carried out at a constant crosshead displacement rate of $\dot{L}_o$. Therefore, the true strain rate continues to decline as the specimen increases its length.

•Derive an equation for the true strain rate as a function of the engineering strain and the engineering strain rate.

Hint use $\varepsilon = \ln(1+\varepsilon_{eng})$. (Keep in mind that the test is carried out at a constant crosshead displacement rate.)

•What will be the (%) discrepancy in the calculation of the true strain-rate at an engineering strain of 100%?

04A.2

Today in class we discussed the determination of the power law "n" in the equation for high temperature deformation.

$$\dot{\varepsilon} = A\frac{\sigma^n}{d^p}e^{-\frac{Q}{RT}}. \qquad (1)$$

where σ is the true stress given by Eq. (1G)

$$\sigma = \sigma_{eng}e^{\varepsilon} \qquad (2)$$

Often experimentalists ignore the significance of using the true stress in their analysis.

For example in the figure on the right we can note from inspection that the value for "n" is lower at low strain rates, than at high strain rates.

•Is it possible to explain this discrepancy because the investigators used engineering stress an engineering strain rate, rather than the true stress and true strain rate, to analyze their data?

(Hint: Use formal equations only to the extent that they reveal the trend in the data).

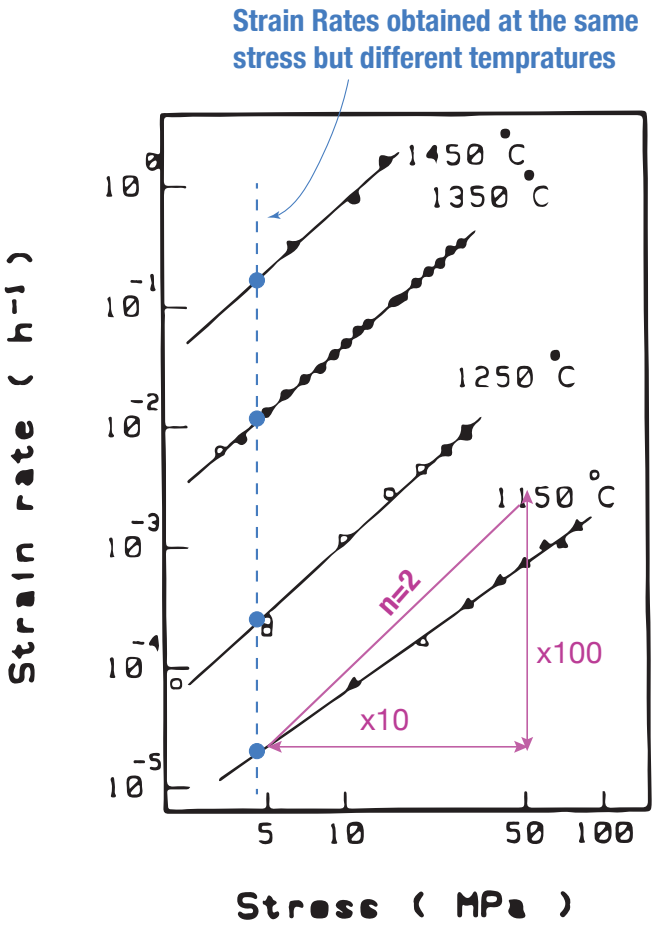

Fig. 3. Steady-state creep rate vs applied stress for Y-TZP