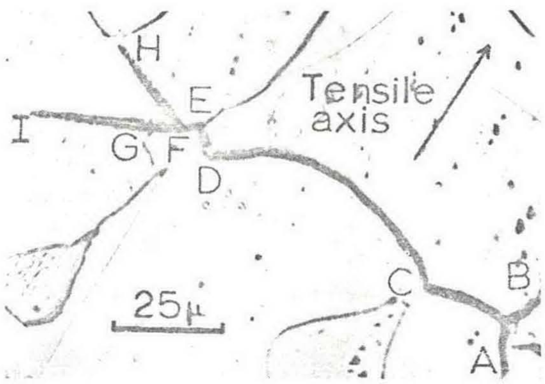
The existence of a constant stress, σ_C, at the transition enabled us to carry out an analysis of the dependence of T_T on the strain rate, $\dot{\varepsilon}$. Let us, as WRONSKI *et al.*[4] have done for molybdenum, assume relationships between stress and temperature[5] and strain rate[8], respectively, of the form:

$$\sigma_Y = A - BT \tag{1}$$

and

$$\sigma_Y = E\dot{\varepsilon}^F \tag{2}$$

where A and B are constant at a given strain rate and E and F are constant at a given temperature. B is approximately equal to 0.3 kg mm^{-2} °K^{-1} for our material at all strain rates in the transition region and E and F have been evaluated for sintered tungsten at 473°K to be ~68 kg mm^{-2} and ~0.09, respectively[8]. If we also



Composite micrograph of a curved surface.

Fig. 2. Non-propagating surface crack in a recrystallized sintered tungsten specimen which cleaved at 442°K at a strain rate of 5×10^{-3} sec^{-1} after 0.6% plastic deformation. Note that the crack follows grain boundaries along AB, AC, CDEF, FH, FG and is transgranular only along the segment GI. (In order to avoid etch-pitting, Murakami's reagent, which is a relatively poor etchant for tungsten, was employed.)

assume that (in the transition region) F is a constant, that the variation of E with temperature is given by eqn. (1), and make use of the identity:

$$\left(\frac{\partial \sigma}{\partial \dot{\varepsilon}}\right)_T \left(\frac{\partial T}{\partial \sigma}\right)_{\dot{\varepsilon}} \left(\frac{\partial \dot{\varepsilon}}{\partial T}\right)_{\sigma} = -1 \tag{3}$$

we derive for the relationship between T and $\dot{\varepsilon}$, for constant σ the expression:

$$\exp(-\dot{\varepsilon}^{0.09}) = K(E_0 - 0.3\,T_T) \tag{4}$$

where K and E_0 are constants. Figure 1 shows T_T plotted against $\exp(-\dot{\varepsilon}^{0.09})$ and it is seen that, although not as good for molybdenum[4], there is a fair agreement between the data and the model.

The constant stress at the transition temperature suggests that this is a critical stress for some mechanism in the fracture process. It appears that the transition coincides with a change in the critical stage in this process, a hypothesis supported by the observation of microcracks in ductile but not in brittle specimens. If the cracks observed in the ductile region are of the type that cause fracture, crack