these then migrate at the low temperatures involved; whereas in the case of the face-centred-cubic metals the experimental evidence indicates that they are not produced[4]. This difference might be related to a difference in stacking fault energies, for in the hexagonal case where slip occurs mainly on the $\{10\bar{1}0\}$ prism planes, the dislocations should have a relatively high stacking-fault energy, probably much higher than copper, nickel or gold. Support for this idea is provided by the results obtained for aluminium[5], a face-centred-cubic metal with a very high stacking-fault energy; for Sosin and Koehler have found that if aluminium single crystals are deformed in tension to an elongation of 15 per cent at 4° K., then there is a 10 per cent recovery of resistivity on annealing at 78° K. One would expect the effect to be much greater for poly-crystals, where the operation of intersecting slip systems can cause increased production of point defects.

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Initiation of Fatigue Cracks in Beta-Brass

FATIGUE cracks have been seen to be initiated in slip bands, twin boundaries and grain boundaries, in a number of investigations on the fatigue behaviour of metals[1-3].

During recent work on the fatigue behaviour of beta-brass a different mode of fatigue crack initiation has been observed, which has not been reported previously in the literature. Certainly, it does not occur in the case of fatigued copper.

Beta-brass was chosen because of the lack of knowledge of the fatigued behaviour of body-centred cubic metals. Polycrystalline material, with an average grain-size of 2 mm., has been fatigued in reverse plane bending at a frequency of 8,400 c./min. Specimens in the form of cantilevers were mechanically polished with care and finally electro-polished prior to fatiguing.

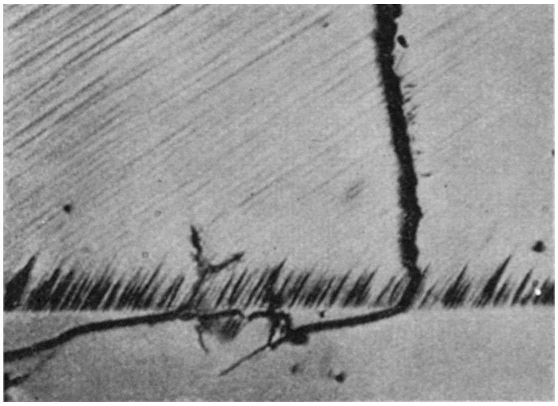

Fig. 1. Surface of fatigued beta-brass specimen. Fatigue cracks initiated in short slip markings adjacent to one side of a grain boundary. Oblique light. (× c. 1,860)

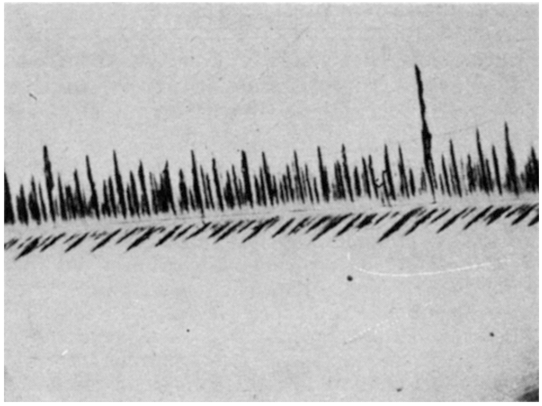

Fig. 2. Surface of fatigued beta-brass specimen. Extrusions on short slip markings adjacent to both sides of a grain boundary. (× c. 1,070)

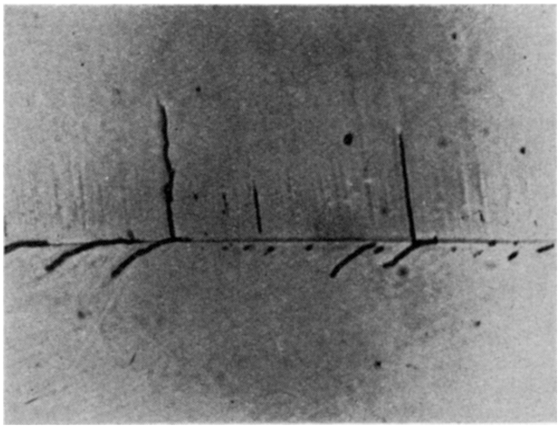

Fig. 3. Surface of fatigued beta-brass specimen. The same area as shown in Fig. 2 after extrusions and slip removed by electro-polishing. Persistent markings, that is, incipient cracks. (× c. 1,070)

One of the main observations has been the initiation of fatigue cracks and the formation of extrusions in short-slip markings, which form adjacent to grain boundaries, and in the majority of cases at an angle to the main slip. These cracks are afterwards propagated into and across the grain boundaries and frequently become linked together.

The most unusual features of this phenomenon are that these cracks form at an angle to the main slip but not in the main slip, and that they form adjacent to the grain boundaries but not in the grain boundaries (Figs. 1, 2 and 3).

Further work leading to a model for the mechanism is in progress.

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