reduction are among the reactions one might expect from such an impurity. Further work is under way in our laboratories aimed at furthering our knowledge of these potentially reactive materials.

We thank Dr. W. G. Hodgson, Stamford, Connecticut, and Dr. R. G. Wheeler, Yale University, for helpful discussions.

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ENGINEERING

Yield Front in the Propagation of Plastic Deformation in Normalized Mild Steel

IT is generally accepted that slip occurs in polycrystalline materials along planes subject to the maximum or principal shear stress, inclined at 45° to the principal stress directions. In tensile tests on parallel specimens it has been reported[1] that plastic working advances behind a front inclined at an angle of 35° to the non-zero principal stress. This is not applicable to specimens having varying cross-sectional area where work-hardening appears to occur simultaneously with the progression of a plastic front which has been observed to be normal to the axis of the specimen. In biaxial stress systems plastic working along slip lines has been observed not to be contained within a front[2]. Bijlaard[3] has examined the simple tension case. Using a similar analysis it can be shown that for non-dilatational incremental plastic strains a 'front' exists at 35° to the cross-section behind which deformation can take place to produce zero normal strain along the front. Such deformation would be free from restraint arising from the material ahead of the front, and it is plausible to believe that the propagation of a front and also fracture by necking may be determined by this property.

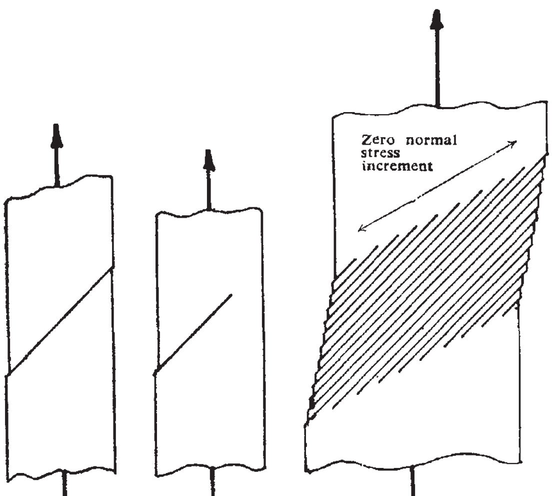

Fig. 1. *a*, Free slip line; *b*, locked slip line with local strain field at head of slip; *c*, stabilized yield front

The plastic strain, however, is produced by a very large number of dislocations, and in a polycrystalline structure these dislocations must occur mostly at 45° to the applied stress. It has been shown that initially slip occurs along the 45° direction, but that as yield continues a well-defined front at 55° to the axis develops. The two effects may be reconciled by a pictorial representation of an idealized slip line and of a system of slip lines. No explanation is offered of the mechanism whereby the front is formed, but it is demonstrated that a front, if formed, would be stable and could propagate.

If these concepts are reconcilable it is necessary to show why in pure shear no such front can exist. Taking principal stresses P, Q, R, with $R = 0$. Suppose $P = -Q$, then for incremental plastic strains the principal strains will be ε and $-\varepsilon$ and the normal strain inclined at an angle β will be:

$$\varepsilon_\beta = \varepsilon \cos^2\beta - \varepsilon \sin^2\beta$$

Thus,

$$\varepsilon_\beta = 0 \text{ when } \cos^2\beta = \sin^2\beta, \text{ or } \beta = 45°$$

There is, therefore, no front behind which principal slip lines can be preferentially arrested.

These effects have been confirmed using strain optically sensitive coating techniques, but further tests are required on other states of biaxial stress.

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Effect of Some Organic Additives on Conduction Current and Breakdown of Insulating Liquids

PREVIOUS work on the gassing properties of insulating liquids revealed beneficial effects of some organic additives on gassing rate of these liquids[1]. The results presented here show that these additives also affect the conduction current and breakdown voltage of insulating liquids.

Test liquid used was *B*30 transformer oil supplied by Gulf Oil (Great Britain), Ltd., and the additives chosen were: azobenzene, azoxybenzene, diphenyl, benzophenone, benzil, anthracene, naphthaquinone and anthraquinone. The concentrations of additives in solutions varied from $2{\cdot}3 \times 10^{-6}$ to $4{\cdot}59 \times 10^{-3}$ mole/100 g of the basic liquid. Test samples, filtered through a No. 5 sintered glass filter, were carefully degassed (10^{-3} mm mercury) and stress conditioned at about 600 kV/cm, for not less than 2 h, before each test. Spherical nickel electrodes 5 mm in diameter were used in all tests. Conduction current and breakdown voltages were measured for four gap settings, namely: 28, 51, 81 and 125µ, and it was possible to measure the conduction current up to breakdown fields. Reported values of breakdown voltages are mean values of 14 runs.

It was found that all additives used did affect the conduction current and breakdown voltage of transformer oil. For the ranges of concentrations used most additives produced a reduction of conduction current and in general an increase in breakdown voltage. Moreover, the results showed that there was an 'optimum' concentration of the additive which gave maximum reduction of conduction current and another, somewhat higher concentration, which resulted in a maximum increase of breakdown voltage. Exceeding these optimum concentrations produced a smaller reduction in conduction current and the gain in electric strength of the solution became less. For