increasing rate as the applied field is increased so that the newly generated pulses contribute to the general growth process of the pre-breakdown current and ultimately bring about an instability and breakdown.

With oxygen in solution, the threshold stress at which pulse activity could be observed increased from about 380 kV/cm for the degassed transformer oil to 500 kV/cm. At this stress, large magnitude pulses were absent and only pulses of smaller amplitudes contributed to the conduction current. Compared with the degassed oil the number of pulses of different magnitudes was now greatly reduced over the whole range of stress examined. Moreover, with oxygen in solution there is a definite quenching effect, for as the electrical stress is increased the number of pulses of different magnitudes increases at a decreasing rate, whereas for the degassed liquid the pulse growth takes place at an increasing rate. The experiments show that the higher the stress the more beneficial is the effect of oxygen.

It would appear that these results provide further evidence for suggested mechanism of electron trapping[3] which occurs when oxygen is present in the liquid.

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## METALLURGY

### Electrocapillary Effect on the Modulus of Elasticity of Metals

THE effect of varying the electrical potential on the mechanical properties of metals has been reported by Pfutzenreuter and Masing[1].

This communication discusses the effects of changing the interfacial energy of mill-finished, polycrystalline aluminium alloys and 99·99 per cent copper, by varying the make-up of the electrolytic double layer through application of an applied d.c. potential during static tensile loading of specimens.

The modulus of elasticity as defined by the slope of the straight line portion of the stress–strain curve showed a significant dependence on applied potential. Solutions of 0·25–1·75 N sodium sulphate were used as the electrolyte since specific absorption of any ions was to be avoided. Evaluation of the test equipment and data computation indicated a variation of not more than ± 3 per cent or in terms of modulus of elasticity not more than $\pm\ 0·30 \times 10^6$ lb./in.$^2$ for aluminium alloys and $\pm\ 0·50 \times 10^6$ lb./in.$^2$ for copper. In these variations are included the relatively small error in the test machine and extensometer fittings and the comparatively large error in determining the slope of the straight line portion of the high magnification stress-strain curves. The average variations, however, were less than ± 1·5 per cent. A loading rate of 0·0025 in./in./min was applied on the tensile specimens using a Tinius–Olsen test machine. The copper specimens were tested in the negatively charged condition only, in order to prevent dissolution. The static modulus of elasticity of aluminium was measured at both polarities.

The elastic modulus versus the applied negative potential for copper in Fig. 1 shows an increasing modulus up to a maximum value at $-3·0$ V potential and a gradual drop from the maximum at higher negative potentials.

In Fig. 2 a minimum is shown for 6061-*T*6 aluminium at $-1·5$ V applied potential and at more negative potentials the static modulus increases as the negative potential is decreased.

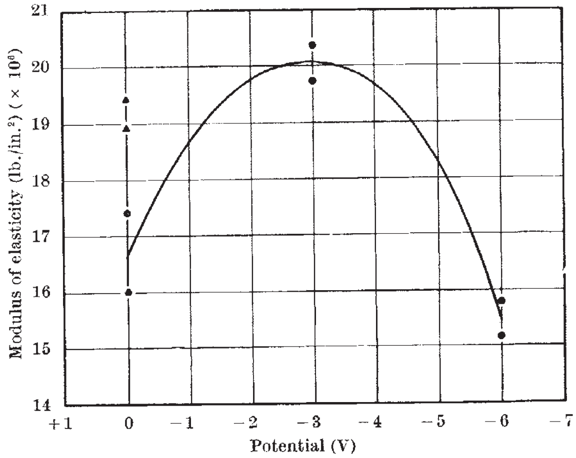


Fig. 1. Applied potential versus modulus of elasticity of 0·035 in. thick annealed polycrystalline copper sheet. ▲, Specimens tested in air, no potential applied; ●, specimens tested in 1·75 N sodium sulphate

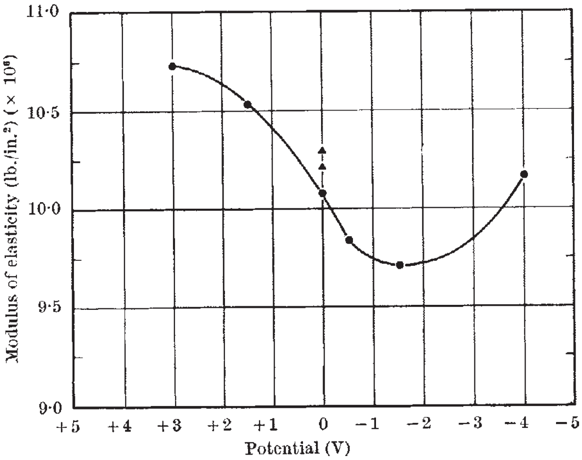


Fig. 2. Applied potential versus modulus of elasticity of 0·035 in. thick 6061-*T*6 aluminum alloy sheet. ▲, Specimens tested in air, no potential applied; ●, specimens tested in 0·25 N sodium sulphate

Measurement of dynamic modulus of elasticity by means of a torsion pendulum was also carried out on these metals. Since these indicated no variation in frequency (and therefore in modulus) on application of a potential, it is postulated that only the micro-yield components are varied by varying potential. This means that minute amounts of plastic deformation have occurred and that the ions in the double layer tend to influence pinning and unpinning of dislocations at the surface.

The minima or maxima in the curves of modulus versus potential may be related to minima or maxima in electrocapillary curves of surface energy versus potential. The possibility exists of positive or negative ions acting as adsorption-locking agents similar to the surface-active agents of Westwood's[2] postulate for lithium fluoride crystals. This may offer an explanation of the phenomenon in the case of the copper. On the other hand, the minimum shown in the 6061 aluminium alloy curve could indicate an unpinning effect triggered by the adsorption of ions on areas affected by cold work or on surface impurities.

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