

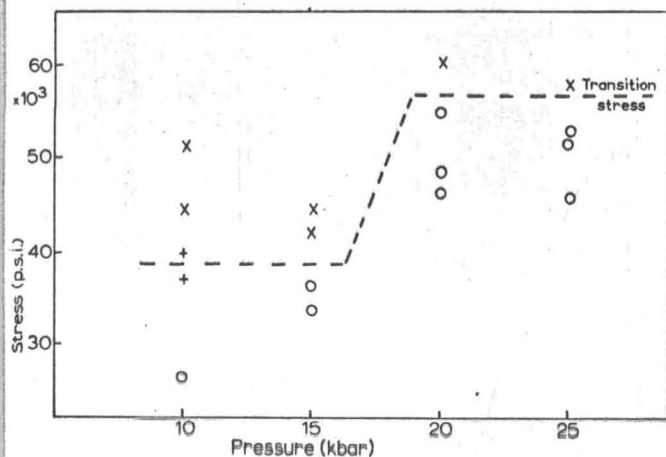


Fig. 2. Variation of transition stress with pressure. The points on the graph represent the ductile yield (O) and brittle fracture (X) stresses of specimens soaked at various pressures and then tested at atmospheric pressure at different strain rates. (Note: (+) indicates that the specimen broke during load drop at yield.)

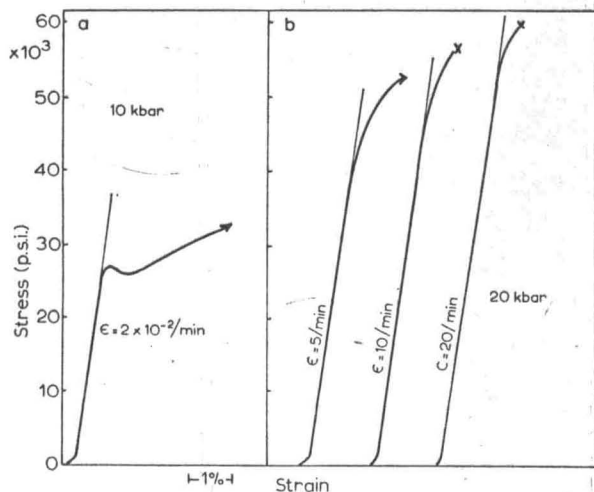


Fig. 3. Stress/strain curves for specimens pressurized at 10 and 20 kbars and then tested (at atmospheric pressure) at the rates shown. Note the absence of yield point phenomena after 20 kbars (X indicates fracture stress; → indicates specimen unbroken).

observed after lower pressures; specimens breaking at or before this maximum load have been classed as brittle in our previous work^{1,2}. The particular value of limiting strain chosen did not greatly affect the measured transition stress since the strain to fracture decreased fairly rapidly with increasing strain rate after 20 and 25 kbars pressure.

3.2. Optical microscopy of fracture surfaces

After all pressures, the (brittle) fracture surfaces were predominantly typical of cleavage. However, as previously reported for specimens pressurized at ~10 kbars^{1,2}, nearly all fractures initiated at small dimpled facets, presumed to be intergranular in nature; in the few remaining cases, the exact origins of fracture were indeterminate.

3.3. Transmission electron microscopy

After low pressures (10 and 15 kbars) the dislocation distribution was extremely non-uniform. After 10 kbars, the few dislocations observed were usually in small groups, frequently around second-phase particles, and the groups were very widely separated; most foils contained no dislocations and others contained (at most) one or two groups. Dislocations were rarely observed in the regions between groups. After 15 kbars, the number of dislocations in each group had increased and more groups were observed (Fig. 4a, b); the separation of the groups remained, however, considerably greater than their size.

After 20 kbars, the density of dislocations within the groups had increased considerably and the number of groups also appeared to have increased. There were virtually no dislocation-free regions of size comparable with the groups (Fig. 4c, d). Finally, after 25 kbars, a fairly uniform distribution of dislocations was observed, apart from very dense tangles around second-phase particles (Fig. 4e, f). It is apparent from Fig. 4 that the dislocation density continues to increase with pressure throughout the entire range, and that the dislocation distribution becomes significantly more homogeneous between 15 and 20 kbars.

After the lower pressures, rows of dislocation loops emanating from particles were observed; diffraction analysis (to be published) of such a row (Fig. 5) showed that these were prismatic dislocations of negative (vacancy) type.

3.4. X-Ray diffraction

Diffraction patterns were obtained by the Schulz and backreflection techniques using Copper radiation from a microfocus source; the (321) reflection, for a Bragg angle of 87°, was chosen in the latter case.

Some reflection spots from specimens pressurized at 25 kbars might have been marginally more diffuse