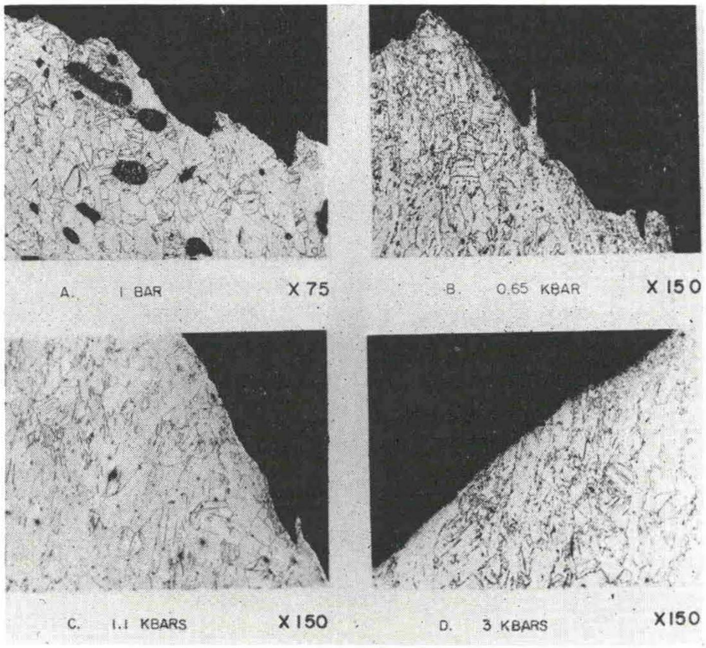

FIG. 13. Effect of pressure on fracture of magnesium at 175°C.

observes that at pressures as low as 0.65 kb (B), the large cavities characteristic of atmospheric pressure fracture (A) are no longer apparent. Theoretically, the hydrostatic pressure that will collapse a spherical void is two-thirds the yield strength. In the case of magnesium at 175°C, this comes out to be equivalent to 0.22 kb, which is in agreement with the metallographic observations on longitudinal sections of specimens tested at 0.20 and 0.45 kb; at 0.20 kb, small rounded voids could still be seen behind the fracture surface, while at 0.45 kb, no internal voids were discernible. At approximately 1 kb, the fracture becomes the shear type (C) along an intense deformation band with no further change at high pressures (D). Again, as in the case of the low-temperature shear fracture occurring above the transition pressure, the structure near the fracture surface cannot be readily resolved. It is likely, particularly at 175°C, that considerable recrystallization has occurred adjacent to the fracture surface due to the high and localized strains.

SUMMARY AND CONCLUSIONS

Superposed hydrostatic pressures to 23 kb enhance the ductilities of magnesium, zinc, cobalt, tungsten, and the martensitic phase of 1045 steel. The pressure–ductility curve of cobalt has an asymptote. The remaining metals initially exhibit nearly linear pressure dependence or pressure insensitivity followed by an abrupt and large increase in ductility over a narrow pressure range.

The observed change in fracture characteristics as a function of pressure is consistent with the model offered in explanation of the effects of pressure upon ductility. This model proposes that pressure will retard those fracture types having a propagation stage dependent upon normal tensile stresses (cleavage, intergranular) or the growth of voids (fibrous, high temperature rupture) thus favoring those dependent principally upon shear strain.

In magnesium, the initial nearly linear dependency of ductility upon pressure corresponds to the retardation of intergranular fracture at and below room temperature and to the prevention of cavities above room temperature. The abrupt increase in ductility after the linear region corresponds to the fracture converting to the shear type along intense deformation bands.

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