at 1600° C. and 10,000 psi for 3 hrs. Some small microvoids remain even though complete grain growth across the interface has occurred. Use of pressures of 30,000 psi or higher virtually eliminates microporosity.

Tungsten-26 w/o Rhenium-to-Tungsten-26 w/o Rhenium

This system lends itself nicely to solid-phase bonding. Fig. 16 shows the high quality of bond achievable at conditions of 1600° C. and 10,000 psi for 3 hrs. Surface preparation consisted of grinding and polishing with alumina grit followed by hydrogen cleaning. Full strength was achieved at the joint. Room-temperature ductility was poor because of the relatively high ductile brittle transition for this material. However, at temperatures above 550° C., the bonds and base metal were quite ductile.

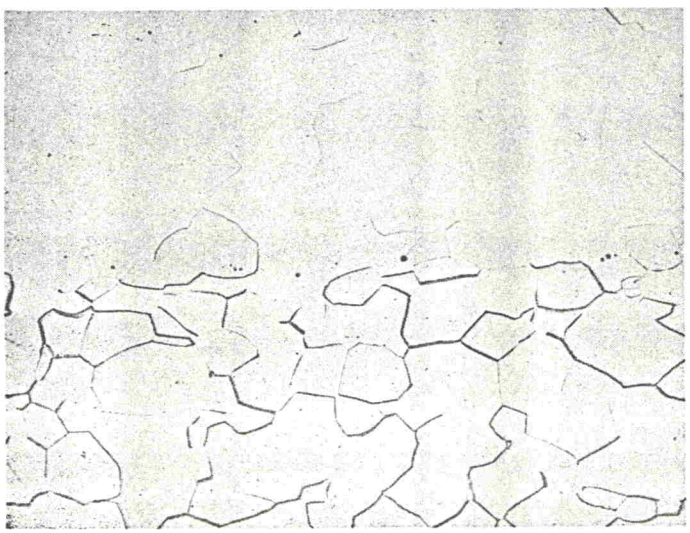

Fig. 17. Bond between tungsten and tungsten-26 rhenium. × 250.

Tungsten to Tungsten-26 Rhenium

Excellent bonding can be achieved between tungsten and tungsten-26 w/o rhenium alloy. Since diffusion dilutes the rhenium content, the brittle sigma phase can be avoided. Fig. 17 shows a bond formed at 1650° C. and 10,000 psi for 3 hrs. Strength of these bonds are excellent and ductility is good if tested above the ductile-brittle transition temperature. Surfaces were prepared by grinding, polishing, and hydrogen cleaning.

Applications

In the preceding section, bond quality and suitability of solid-phase bonding to various refractory metal combinations was explored. It is not suf-