

beneficial. Since only a limited Kirkendall effect was noted in heat treatments up to 2200° C., there does not appear to be an inherent problem in the use of higher bonding temperatures.

#### Rhenium-to-Rhenium

Excellent bonds between rhenium surfaces can be achieved at 1600° C. and 10,000 psi for 3 hrs. A surface preparation of grinding and polishing with alumina grit followed by hydrogen cleaning at 1100° C. has been satisfactory. These bonds have strength and ductility equivalent to the base material. Fig. 12 shows a typical rhenium self-bond. Note the heavy twinning in the microstructure which resulted during preparation of the metallographic specimen.

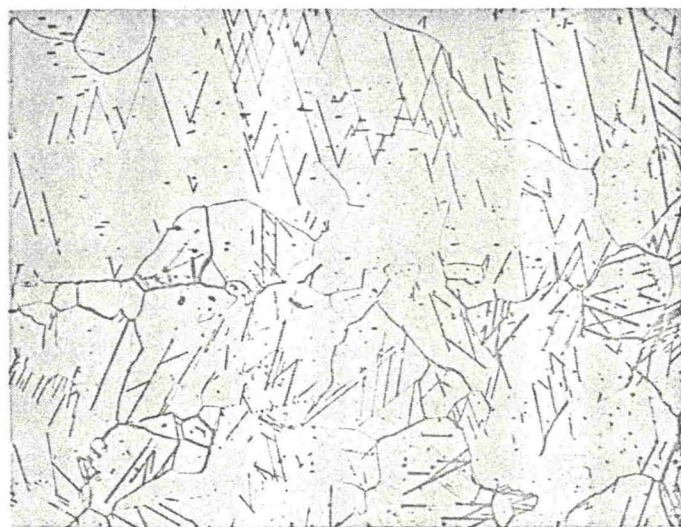


Fig. 12. Rhenium self bond. × 250.

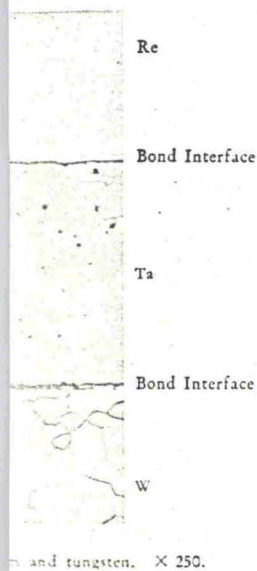
#### Rhenium-Tungsten

Excellent bond strength can be achieved in this system; however, the bond is very brittle due to the formation of intermetallic compounds. This bond is satisfactory for compression loading applications. Fig. 13 shows a bond which was formed at 1600° C. and 10,000 psi for 3 hrs. and then heat treated at 2200° C. for 1 hr. Note that diffusion is quite sluggish and that no Kirkendall effect is evident under these conditions.

#### Rhenium-Zirconium

Fig. 14 shows a bond formed between rhenium and zirconium at 1100° C. and 10,000 psi for 3 hrs. Note that excessive diffusion has occurred in this case and it would be desirable to decrease both time and temperature of the

hydrofluoric acid solu-  
ed 10,000 psi for 3 hrs.  
rent metal strength and  
pick-up during process-



bond formed between  
for 3 hrs. The bond as  
propagation and fracture  
behavior is attributed  
temperature only increases  
properties of the joint.  
to 2200° C. in bonded

at to the molybdenum-  
appear required to get  
formed at 1600° C. and  
the joint was relatively  
temperatures would be