Discussion

We note a striking similarily in the dependence of the interaction term g on pressure and electron concentration in the binary Zr-Nb-Mo and Hf-Ta-W alloy systems. In both cases the relation

$$\Delta n = a \cdot \Delta p \tag{4}$$

is obeyed, the constant a being $0.40 \cdot 10^{-6}$ bar^{-1} and $0.30 \cdot 10^{-6}$ bar^{-1}, respectively. In our paper on Zr-Nb-Mo the apparent equivalency of application of pressure and adding electrons to the conduction band, represented by $\Delta n = a \Delta p$, was interpreted as being due to a shift of the narrow d-band with respect to other broader (s and p) bands with pressure, leaving the shape of the d-band unchanged, i.e. rigid. We adopt the same picture for Hf-Ta-W alloys. It is then interesting to compare the experimental results with band calculations which have been performed for Nb and Ta by Mattheiss in a consistent manner[11]. From these calculations it can be deduced that, within the composition ranges of our experiments, the variation of n with energy is very nearly linear, i.e.

$$\Delta n = c \cdot \Delta E \tag{5}$$

with $c \approx 30$ Rydberg^{-1} for Nb and $c \approx 24$ Rydberg^{-1} for Ta. In the rigid band description this can be combined with $\Delta n = a \cdot \Delta p$ to yield

$$\Delta E_F = \frac{a}{c} \cdot \Delta p. \tag{6}$$

Inserting the appropriate numbers of a and c for both alloy systems one obtains $a/c = 1.33 \cdot 10^{-8}$ Rydberg bar^{-1} for Zr-Nb-Mo and $a/c = 1.25 \cdot 10^{-8}$ Rydberg bar^{-1} for Hf-Ta-W. Thus, within the error of this simple calculation, the variation of the fermi energy E_F with pressure is the same for both the $4d$ Zr-Nb-Mo and the $5d$ Hf-Ta-W alloys. If, as was implied above, the broader bands show negligible variation of density of states with energy, this is equivalent to saying that pressure will shift the narrow d-band energetically by the same amount in both $4d$ and $5d$ alloys.

Conclusion

The high pressure experiments uncover not only a intimate correlation between the pressure and electron concentration dependence of the interaction term g in each of the $4d$ and $5d$ alloy series; these series seem to be related also on the basis of electronic band calculations. This

11 Mattheiss, L. F.: Phys. Rev. **B1**, 373 (1970).

suggests that for these metals of the central part of the transition series the interaction responsible for superconductivity is governed by the electronic density of states. Obviously disturbances due to paramagnon effects or other complications affecting the transition temperature are here negligible.

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