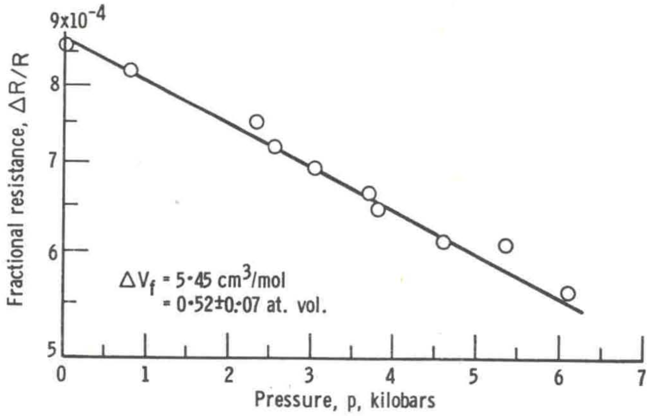

FIG. 5. Influence of pressure on fractional resistance retained in gold wires quenched from 600°C.

who derived ΔV_f indirectly by combination of the vacancy formation energy and his value of the vacancy concentration obtained from the energy released on annealing vacancies in gold foils with the resistivity change of gold wires per fractional volume change measured by BAUERLE and KOEHLER.[10]

Calculated estimates of TEWORDT[21] for the vacancy formation volume in copper ranging from 0·47 to 0·55 at. vol. are also in agreement with the measured value.

A theoretical estimate of the degree of relaxation of nearest neighbor atoms to the vacancy can be made assuming the ESHELBY[22] elastic continuum approximation. For f.c.c. metals, the relaxation δ is given by

$$\delta = \frac{V_f}{12\pi\sqrt{(2)(1-\sigma/1+\sigma)}},$$

where V_f is the measured formation volume and σ is Poisson's ratio.

Poisson's ratio of 0·42 for gold[23] and the measured formation volume of 0·52 at. vol., give the inward relaxation of nearest neighbors to the vacancy as 2·4 per cent. This value compares favorably with a relaxation of 2·24 per cent for Cu calculated using a Morse potential function.[12] This remarkable agreement tends to justify the validity of the use of a simple pairwise potential function for lattice calculations in which drastic atomic rearrangement does not occur.

The measured formation volume, when added to EMRICK's vacancy migration volume for gold[8] yields an activation volume for self-diffusion in gold of 0·67 at. vol. This value may be compared with 0·7 at. vol. measured for self-diffusion in lead[5] and 0·9 at. vol. reported for self-diffusion in silver.[6] To the author's knowledge, the activation volume for self-diffusion in gold has not been measured; however, because both the formation volume and the migration volume have been measured, a direct comparison with the diffusion volume would be most interesting.

Finally, the Bauerle and Koehler resistivity change of gold wires accompanying a fractional volume change $\Delta\rho/(\Delta V/V) = 3{\cdot}2\times10^{-4}\ \Omega/\text{cm}$ and the fractional formation volume measured can be used to calculate the resistivity per atomic percent vacancies. The value obtained, 1·67 Ω/cm/at.% vacancies, is in fair to good agreement with several theoretical estimates for copper made since 1953[24] ranging from 1·25 to the most recent value 1·67 Ω/cm/at. % vacancies.

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REFERENCES

1. MORI T., MESHII M. and KAUFFMAN J. W., *J. Appl. Phys.* **33**, 2776 (1962).

2. Liu T. and Drickamer H. G., *J. Chem. Phys.* **22,** 312 (1954).
3. Nachtrieb N. H., Weil J. A., Catalano E. and Lawson A. W., *J. Chem. Phys.* **20,** 1189 (1952).
4. Nachtrieb N. H. and Lawson A. W., *J. Chem. Phys.* **23,** 1193 (1955).
5. Nachtrieb N. H., Resing H. A. and Rice S. A. *J. Chem. Phys.* **31,** 135 (1959).
6. Tomizuka C. T., *Progress in Very High Pressure Research*, p. 266. Wiley, New York (1961).
7. Girifalco L. A. and Grimes H. H., *Phys. Rev.* **121,** No. 4 (1961).
8. Emrick R. M., *Phys. Rev.* **122,** No. 6, 1720 (1961).
9. Huebener R. P. and Homan C. G. (private communication).
10. Bauerle J. E. and Koehler J. S., *Phys. Rev.* **107,** No. 2, 444 (1957).
11. DeSorbo W., *Phys. Rev.* **117,** No. 2, 444 (1960).
12. Girifalco L. A. and Weizer V. G., *J. Phys. Chem. Solids* **12,** 260 (1960).
13. Koehler J. S., Seitz F. and Bauerle J. E., *Phys. Rev.* **107,** 1499 (1957).
14. De Jong M. and Koehler J. S., *Phys. Rev.* **129,** 40 (1963).
15. De Jong M. and Koehler J. S., *Phys. Rev.* **129,** 49 (1963).
16. Kauffman J. W. and Koehler J. S., *Phys. Rev.* **88,** 149 (1952).
17. Sigmund Cohn Company, Mount Vernon, New York.
18. Meechan C. J. and Eggleston R. N., *Acta Met.* **2,** 680 (1954).
19. Jackson J. J., Office of Ordnance Research Contract. DA-11-022-ORD-2691 Tech. Rept. No. 2. Illinois University (1960).
20. These values have been summarized in a paper by Simmons R. O. and Balluffi R. W., *Phys. Rev.* **125,** 862 (1962).
21. Tewordt L., *Phys. Rev.* **109,** 61 (1958).
22. Eshelby J. D., *Solid State Physics Advances in Research and Applications* (eds. Seitz F. and Turnbull D.), Vol. 3. Academic Press, New York (1956).
23. Smithells C. J., *Metals Reference Book*. 3rd Edition, Vol. 2. Butterworths, London (1962).
24. Summarized by Blatt F. J., *Solid State Physics in Advances in Research and Applications* (eds. Seitz F. and Turnbull D.), Vol. 4. Academic Press, New York (1957).