01 Jan 1972

Comment On The Nature Of The Disaccommodation In HCP Co-C Alloys

J. Keiser

Manfred Wuttig
Missouri University of Science and Technology

Recommended Citation

J. Keiser and M. Wuttig, "Comment On The Nature Of The Disaccommodation In HCP Co-C Alloys," *Scripta Metallurgica*, vol. 6, no. 10, pp. 955 - 956, Elsevier, Jan 1972.
The definitive version is available at https://doi.org/10.1016/0036-9748(72)90152-4

Scripta METALLURGICA Vol. 6, pp. 955-956, 1972 Pergamon Press, Inc.
Printed in the United States

COMMENT ON THE NATURE OF THE DISACCOMMODATION IN HCP Co-C ALLOYS

J. Keiser and M. Wuttig

Department of Metallurgical Engineering
University of Missouri - Rolla
Rolla, Missouri 65401

(Received August 19, 1972)

Mechanical and magnetic relaxations in Co-C alloys may occur in the stable hcp or the metastable fcc phases. Mechanical relaxations have been observed in the fcc phase only and have been attributed to the reorientation of carbon polymers[1]. Magnetic reorientation type relaxations are known to occur in both phases but the identity of the carbon defect in the hcp phase is still unclear[2]. In this note the concentration dependence of the disaccommodation due to carbon reorientation in the hcp phase will be reported. The results of the test suggest that the reorienting defect is a carbon pair.

Rods of 99.999% cobalt supplied by United Mineral and Chemical Company were carburized by heating at selected temperatures and times in a quartz ampule containing carbon powder and evacuated to 500μ air. This anneal was terminated by an ice water quench. The samples were subsequently homogenized in a better than 20μ vacuum at 1200°C for three hours and again ice water quenched. The carbon concentration was determined by weighing.

The disaccommodation apparatus was the same as that used for previous studies[3]. A value proportional to the amplitude of the disaccommodation (hereafter called relaxation amplitude) was determined by measuring the difference of the initial permeability isothermally one and ten minutes after demagnetization.

A measuring temperature of 70°C was selected because it was felt that at this temperature the aftereffect would be predominantly due to carbon atoms in the hcp phase. Earlier work showed that in polycrystalline cobalt several relaxations occur[2]. The lowest temperature relaxation centered around 90°C is that attributed to carbon in hcp cobalt. Hence, choosing a measuring temperature on the low temperature side of this peak made it possible to examine essentially only the one relaxation process of interest.

The fcc-hcp transformation in cobalt is a martensitic transformation. The relaxation amplitudes will thus depend on the (in)completeness of the transformation. For a check, the relaxation amplitude was measured between 70°C and 120°C after quenches in ice water, in liquid N_2, and in liquid He. It was found that the relaxation amplitude characteristic of the hcp phase was not a function of the quenching temperature. It was thus concluded that the relative amount of hcp phase, while probably not 100%, was sufficiently constant and all final data were taken from samples quenched in ice water.

From Fig. 1 it can be seen that the relaxation amplitude investigated varies as the square of the carbon concentration. Since the concentration of defect pairs is proportional to the square of the defect concentration, the disaccommodation observed in hcp Co-C alloys at 70°C is predominantly due to the reorientation of carbon pairs. A similar conclusion has also been reached recently for Ti-O alloys[4].

It is also noted from Fig. 1 that the relaxation amplitude does not go to zero with vanishing carbon content. This background effect has been observed many times before[5,6] and it can be subtracted from the main relaxation in interpreting the data just as is done in internal friction studies.

This work was supported by the National Science Foundation.

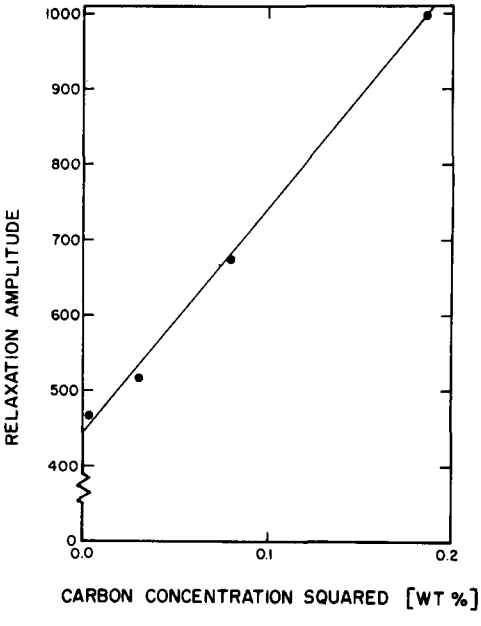

Fig. 1: Relaxation Amplitude of Co-C alloys measured at 70°C.

References

1. G. Mah and C. A. Wert, Trans. AIME 242, 1211 (1968)
2. J. Keiser and M. Wuttig, Acta Met. 19, 445 (1971)
3. J. Keiser and M. Wuttig, Phys. Rev. B5, 985 (1972)
4. K. M. Browne, Acta Met. 20, 507 (1972)
5. H. Kronmüller, *Vacancies and Interstitials in Metals*, A. Seeger, D. Schuhmacher, W. Schuhmacher, W. Schilling and J. Diehl, ed's, North Holland Publishing Company (1970)
6. L. Gerward, Phys. Stat. Solidi 22, 659 (1967)