EFFECTIVE MAGNETIC FIELD AT THE Co^{60} NUCLEUS IN THE CoPd ALLOY

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Submitted 25 February 1966
ZhETF Pis'ma 3, No. 8, 318-320, 15 April 1966

Much attention has been paid recently to investigations of alloys of transition metals, particularly alloys based on elements of the palladium group. It was observed that rather small additions of ferromagnetic metals (Fe, Co) to Pd cause the alloy to become ferromagnetic. For example, addition of 0.1 at.% Co to Pd is sufficient to make the resultant alloy ferromagnetic [1].

Measurements with the aid of the Mossbauer effect have made it possible to determine H_{eff} at the Fe^{57} nucleus in the alloys FePd and CoPd [2,3]. The presence of an effective field at the nucleus in alloys with small additions of ferromagnets of the iron group offers possible evidence that a long-range interaction exists between the magnetic moments of the impurity atoms and the conduction electrons of the main matrix of the alloy [2]. Measurements of H_{eff} at the Fe^{57} nucleus in CoPd and FePd alloys, however, yielded different results: the field in the FePd alloys exhibits a dependence on the Fe concentration, whereas the field in the CoPd alloys, up to 3 at.% Co, remains constant at approximately the value of H_{eff} in pure Fe.

It is of interest to measure the value of H_{eff} at the Co nuclei in the CoPd alloy. The Mossbauer effect makes it possible to obtain H_{eff} only for Fe^{57} nuclei; the field at the Co nuclei can be measured by the method of orientation of nuclei, and if radioactive Co^{60} nuclei are used, it is possible to carry out the measurements at rather low Co concentrations.

We measured H_{eff} at the Co^{60} nucleus in an alloy of 0.3 at.% Co with Pd, by determining the anisotropy of the γ radiation of oriented Co^{60} nuclei. The procedure used was similar to that described earlier [4]. The cooling agent was a block of potassium chrome alum. The investigated sample, constituting a disc 3 mm in diameter and 0.3 mm thick, was soldered to the end of the cold finger, which was pressed into the salt. We measured the intensity of 1.33- and 1.17-MeV γ quanta from Co at angles 0° and 90° to the external orienting field (H_{ext} = 5.7 kOe). The temperature was determined from the magnetic susceptibility of the chrome alum, with the data of [5] used to convert the magnetic temperature into thermodynamic temperature.

To control the temperature at the end of the cold finger, at the location of the investigated sample, we measured the effective magnetic fields at the Co^{60} nuclei in an alloy of 50% Co and 50% Fe (permendur) and in metallic cobalt [1)]. The measurements have shown that thermal equilibrium is established between the cooling salt and the sample at $T \sim 0.03$°K, and the values of H_{eff} obtained in both cases agree with the published data. The effective field at the Co^{60} nucleus in the CoPd alloy was measured under the same conditions (the same salt and the same cold finger), and a value $H_{eff} = (2.6 \pm 0.2) \times 10^5$ Oe was obtained. This value of H_{eff} exceeds the field in the metallic Co ($H_{eff} = 2.150 \times 10^5$ Oe) [6]. The result shows that the Co ion behaves somewhat differently than the Fe ion when alloyed with Pd, where the field at the Fe^{57} nucleus is lower at smaller concentrations of Fe than in pure Fe [2].

The large value of H_{eff} is apparently connected with the large local moment at the impurity ferromagnetic Co atom (at a concentration of 0.3 at.% Co in Pd, the local moment per atom of Co is $\sim 9\ \mu_B$ [1]). On the other hand, the increase of H_{eff} at the Co nucleus in the investigated alloy can be due to the change in the contribution of the spin density due to the conduction s-electrons, compared with metallic cobalt.

It is of interest to determine the dependence of H_{eff} on the Co concentration. Work in this direction is now in progress.

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1) Unfortunately, it is impossible to use in this case the direct measurement of the temperature by using the anisotropy of Co^{60}, as was done by us earlier [4]. The data of the earlier work, however, offer evidence that at $T \sim 0.03°K$ the temperature gradient between the salt and the sample is small.

MEASUREMENT OF THE CROSS SECTIONS OF ION-ATOM COLLISIONS AT LOW ENERGIES BY THE METHOD OF OVERTAKING BEAMS

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Submitted 25 February 1966
ZhETF Pis'ma 3, No. 8, 321-323, 15 April 1966

Measurement of the cross sections of ion-atom collisions at energies below ~100 eV by customary methods is a complicated matter, principally because the guidance of the ion beam through the apparatus becomes much more difficult in this energy region, and the scattering of the ion beam by the target exerts a greater influence on the measurement results. An experimental solution free of these shortcomings is nevertheless possible. To this end, the two colliding particles should have sufficiently high energy in the laboratory frame. To obtain low interaction energy, on the other hand, all that is needed is a small difference in the particle velocity at the instant of collision. Conditions of this kind can be obtained when monochromatic particle beams cross at a small angle ("overtaking beams"). Since the absolute difference of the energies of the colliding particles always exceeds the interaction