FERROMAGNETIC RESONANCE ON ANNEALED AMORPHOUS Co—Pd—Si ALLOYS[1])

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FMR measurements at room temperature on the amorphous alloy $Co_{10}Pd_{70}Si_{20}$ in the frequency of 9.37 GHz are reported. The angular dependence of the resonance field B_r and the linewidth ΔB discussed. For the "as quenched" and annealed samples from the measured resonance fields, the effective magnetic polarization (J_{eff}) and the spectroscopic splitting factor (g-factor) are determined. The experimental results J_{eff} and the g-factor are compared with the values reported by other authors.

I. INTRODUCTION

The magnetic properties of amorphous alloys have been recently the subject of extensive experimental and theoretical activity. A great amount of experimental and theoretical work has been done in order to determine the influence of the topological disorder on the various magnetic properties (e.g. the coercive force, the susceptibility, the saturation magnetization). From FMR measurements for the "as quenched" sample $Co_xPd_{80-x}Si_{20}$ ($x = 10, 12, 15, 20$ at %) there were determined: the linewidth in parallel and perpendicular configuration, the value of magnetic polarization and the g-factor [1]. The influence of annealing on the coercive force and the initial susceptibility of amorphous alloys $Co_xPd_{80-x}Si_{20}$ with cobalt concentration $x = 8, 9, 10$ at % were shown in [2].

II. EXPERIMENTAL

The chemical composition of the material was $Co_{10}Pd_{70}Si_{20}$. The specimens produced by a one roller method [3] were in the form of a ribbon 2 mm broad and (20 ± 2) μm thick. The stripe of about 10 cm long was cut out from the ribbon and subjected to the annealing procedure in a argon atmosphere. The sample was annealed at a temperature of 400 °C for 15 minutes.

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A microwave spectrometer working in the frequency of 9.37 GHz and static magnetic field intensities of up 0.75 T has been used. For the measuring procedure the ribbons were about 10 mm long. The angular dependence of the resonance field an the linewidth were measured at angles ϑ from 0° to 180° and 0° to 90°, respectively.

III. RESULTS AND DISCUSSION

FMR experiments gave rather broad resonance lines. The angular dependence of B_r is shown in Fig. 1.

For the simple case it is useful that a magnetic in-plane anisotropy of a ferromagnetic metal is small. The effective magnetic polarization and the g-factor in such a case can be expressed by the equations

$$\omega = \gamma \sqrt{B_r''(B_r'' + J_{eff})} \qquad (1)$$

$$\omega = \gamma (B_r^{\perp} - J_{eff}) \qquad (2)$$

$$\gamma = \frac{g\,\mu_B}{\hbar}, \qquad \hbar = \frac{h}{2\pi}$$

The symbols " and ⊥ denote a parallel and perpendicular orientation of the applied field to the plane of the ribbon, μ_B is the Bohr magneton, h is the Planck constant. The calculated values of J_{eff} and the g-factor for "as quenched" and annealed samples are listed in Table 1.

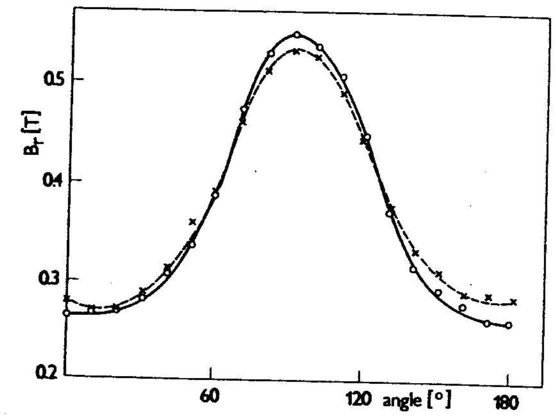

Fig. 1 Angle dependence of the resonance field B_r. × "as quenched" sample, ○ sample annealed at 400 °C.

Table 1

	J_{eff} [T]	g-factor
"as quenched"	0.179	1.89
annealed at 400 °C	0.199	1.91

The calculated value of J_{eff} is comparable with that reported by other authors [1], while the g-factor from our experiment is smaller. This decrease of the g-factor is likely to be caused by the neglect of the in-plane anisotropy in Eqs. (1), (2). Let us remark that the experiments on similar samples have shown the effective in-plane anisotropy field $2K_i\ M \approx 30$ mT [5]. Indeed, if we assume that the parallel resonance field corresponds to the heavy in-plane direction, this leads (for $2K_i\ M \approx 30$ mT) to the negative shift $\Delta g \approx -0.1$. The real g value should be thus by about 0.1 larger than the calculated from Eqs. (1), (2). (At the same time the real value of J_{eff} should be by 30 mT less).

In Fig. 2 we see the angular dependence of ΔB. Here it can be observed that the mininum linewidth for the angle of 90° is for the annealed sample smaller. This may be caused by a decrease of the strain in the sample. The discussion of the dependence ΔB (ϑ) could be made only after a more detailed study of the different samples, which is in progress.

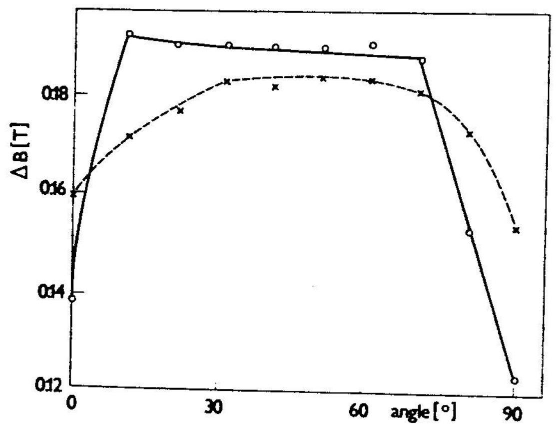

Fig. 2 Angle dependence of the linewidth ΔB. × "as quenched" sample. ○ sample annealed at 400 °C.

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ФЕРРОМАГНИТНЫЙ РЕЗОНАНС ОТОЖЖЕННЫХ АМОРФНЫХ Co Pd Si СПЛАВОВ

В работе излагаются результаты ФМР измерений (при комнатной температуре) аморфных $Co_{10}Pd_{70}Si_{20}$ сплавов на частоте 9,37 GHz. Обсуждается угловая зависимость резонансного поля B_r и ширины линии ΔB. Определены эффективная магнитная поляризация (J_{eff}) и спектроскопический фактор расщепления (g-фактор). Экспериментальные значения для J_{eff} и g-фактора сравниваются с их значениями, полученными другими авторами.