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BARKHAUSEN EFFECT IN AMORPHOUS ELECTRODEPOSITED FILMS

ЭФФЕКТ БАРКГАУЗЕНА В АМОРФНЫХ ГАЛЬВАНИЧЕСКИХ ПЛЕНКАХ

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The Barkhausen noise yields the information about the process of magnetization of ferromagnetic samples at a slowly changing magnetic field and it reacts sensitively to the changes of the domain structure in the whole sample volume. This paper reports about the results found in studying irreversible magnetizing processes in some electrodeposited films.

Amorphous films $Fe_{86}P_{14}$, $Fe_{68}Co_{20}P_{12}$, $Fe_{82}Mn_1P_{17}$, $Co_{76}P_{24}$ and $Ni_{88}Mn_1P_{11}$ were electrodeposited from baths based on those described by Brenner [1] onto Cu-glass substrates. The deposited films were then removed from their substrates. The dimensions of the used samples were $20\times20\times0.001\ mm^3$. Barkhausen impulses (B.i.) were registered by the usual method. The magnetizing field was controlled following a triangle function, the frequency of which was 1.6×10^{-3} Hz. The maximum value of the external magnetic field was identical for all specimens and was always sufficient to reach technical saturation.

The observed dependences $n(H)$ of the total number of registered B.i. upon the external field during the sample magnetization reversal for room temperature are shown in Fig. 1. The same situation for the temperature of liquid nitrogen is shown in Fig. 2. From these dependences we have found the values of "Barkhausen" coercive forces by the method described in [2] (see Table 1). The macroscopic value of H_{cB} can be greater because the Barkhausen effect reacts only to irreversible processes.

The courses of $n(H)$ function showed in Fig. 1 and Fig. 2 are typical for soft magnetic materials. All functions $n(H)$ are for the studied samples qualitatively the same. However, they differ from one another in both the total number of impulses and the shape of the $n(H)$ function in the region of negative magnetizing fields. It is seen from these figures that the number of registered Barkhausen impulses decreases with temperature. This decrease is different for various samples. For example, in the case of $Ni_{88}Mn_1P_{11}$ at room temperature there was not registered any B.i., for $Co_{76}P_{24}$ the observed number of impulses at liquid nitrogen temperature was higher in order than that at room temperature. A weak temperature influence is observed for the $Fe_{86}P_{14}$ samples. This fact can be connected with the different temperature behaviour of the sample magnetic polarization. The coercive force H_{cB} of electrodeposited films is regularly higher in order than that for material prepared by this method of the rapid rotation mill technique. It is due to a relatively high concentration of defects and local stress-centres in electrodeposited materials. The decrease of the "Barkhausen" coercive force H_{cB} with

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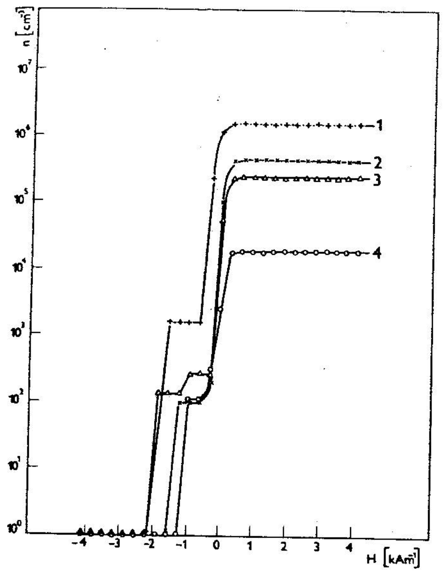

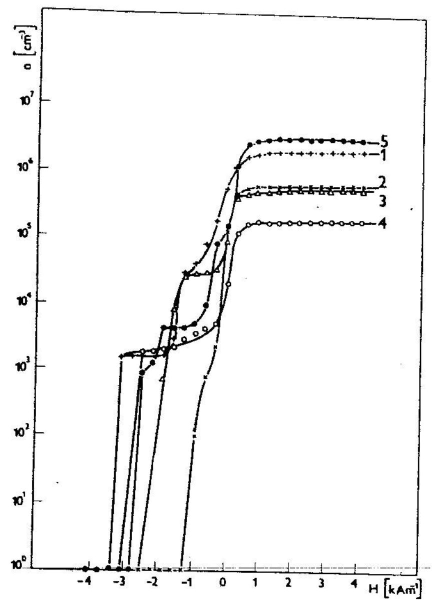

Fig. 1. Dependences n versus H of the total number of registered Barkhausen impulses along one branch of the hysteresis loop at room temperature. (1 — $Fe_{68}Co_{20}P_{12}$; 2 — $Fe_{82}Mn_1P_{17}$; 3 — $Fe_{86}P_{14}$; 4 — $Co_{76}P_{24}$; 5 — $Ni_{88}Mn_1P_{11}$) Content of transition metals is in at. %.

Fig. 2. Total number n of registered Barkhausen impulses versus the external field H at the temperature of liquid nitrogen. (Curves are numbered as in the previous figure).

increasing temperature is obviously influenced by the temperature dependence of the magnetostriction constant. The decreasing number of registered B.i. with temperature is connected with the increase of amplitude of the energetic barriers. It leads to the increase of the sample volume that the magnetization changes by one Barkhausen jump. In the result we observe a decrease of the total number of B.i.

For a more detailed elaboration of the problem it will be necessary to study the correlation mechanism between the Barkhausen jumps.

Table 1

Sample	$T=78$ K	$T=295$ K
	H_{cB} [$A\cdot m^{-1}$]	H_{cB} [$A\cdot m^{-1}$]
$Co_{76}P_{24}$	190	120
$Fe_{86}P_{14}$	150	100
$Fe_{82}Mn_1P_{17}$	150	100
$Ni_{88}Mn_1P_{11}$	350	—
$Fe_{68}Co_{20}P_{12}$	190	40

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