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METALLIC COATING PROTECTION ON DIELECTROMAGNETS PREPARED FROM MIXTURE OF HARD MAGNETIC POWDERS

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Abstract - Our team works on mixture of hard magnetic materials. As hard magnetic material we used mixture of powders: melt-spun ribbon Nd-Fe-B, ferrite and Alnico. Their different mixtures are basic material for dielectromagnets under our investigation. Main disadvantage of dielectromagnets with Nd-Fe-B alloy powder as a component is a low corrosion resistance. Protection against corrosion is covering dielectromagnets with metallic or organic coating film. The coating film protects dielectromagnets from free particles on the surface and low resistance for mechanical stresses too. The surface of dielectromagnets prepared from mixture of powders if formed by metallic particles - powder of Nd-Fe-B and Alnico, particles of oxide - powder of ferrite and particles of resin - bonding materials. Team work on technology of laying the metallic coating on dielectromagnets prepared from mixture of mentioned powders. Papers show the results of initial investigation on metallic coating technology. It shows influence of type and used technology of the metallic coating film on magnetic properties of dielectromagnets.

I. INTRODUCTION

Initial investigation on dielectromagnets prepared from mixture of melt-spun ribbon Nd-Fe-B and strontium ferrite shows their good properties [1]. This is the reason why researches are continued, not only on this mixture. The mixture of melt-spun ribbon Nd-Fe-B and powdered Alnico is included to research.

Problem with magnets and dielectromagnets prepared from Nd-Fe-B alloy is their corrosion resistance.

Corrosion resistance of Nd-Fe-B alloy on activity of aggressive media is very low. It makes necessary to protect magnets and dielectromagnets with these alloys with coating film. The second reason to protect it with coating film are free magnetic particles on the surface. These free magnetic particles are dangerous for delicate electronic equipment. When one of component of dielectromagnets from mixture of hard magnetic powders is powdered melt-spun ribbon prepared from Nd-Fe-B alloy than it needs a film protection.

The purpose of this work is to find technology of metallic coating this kind of dielectromagnets and to investigate influence of this coating process onto magnetic properties of dielectromagnets.

II. EXPERIMENTAL

Dielectromagnets were prepared from mixture of two kinds of hard magnetic powders.

Melt-spun ribbon Nd-Fe-B powder produced by General Motors - MQP-D was mixed with strontium ferrite in following composition:

75 wt.% MQP-D + 25 wt.% strontium ferrite
50 wt.% MQP-D + 50 wt.% strontium ferrite
25 wt.% MQP-D + 75 wt.% strontium ferrite

The second type of mixture was prepared from MQP-D and powdered Alnico in following composition:

75 wt.% MQP-D + 25 wt.% powdered Alnico
50 wt.% MQP-D + 50 wt.% powdered Alnico
25 wt.% MQP-D + 75 wt.% powdered Alnico

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In both cases one-component epoxy-resin Epidian 100 was used as resin.

Dielectromagnets were made by technique described elsewhere [1,2,3]. The samples of dielectromagnets were electroplated with tin by technique used in electroplating of copper wires [4].

The magnetic properties were measured with Permagraph - Hysteresisgraph made by Electro - Physic, at room temperature. The structure was determinated by metallographic microscope type MeF-2 of Reichert production.

III. RESULTS AND DISCUSSION

Magnetic properties of prepared samples of dielectromagnets from mixture of powders were measured before their coating by electroplating. Table 1 shows magnetic properties of dielectromagnets from mixed MQP-D and strontium ferrite.

Table 1 Magnetic properties of dielectromagnets from mixture of melt-spun ribbon Nd-Fe-B alloy - MQP-D and strontium ferrite

Composition	Br kGs	H_{ci} kOe	H_{cb} kOe	$(BH)_{max}$ MGsOe
75 wt.% MQP-D + 25 wt.% strontium ferrite	4,5	11,0	3,8	4,5
50 wt.% MQP-D + 50 wt.% strontium ferrite	3,0	9,6	2,4	1,9
25 wt.% MQP-D + 75 wt.% strontium ferrite	2,0	5,0	1,6	0,9

Magnetic properties of dielectromagnets from mixed melt-spun ribbon - MQP-D with powdered Alnico are shown in Table 2.

Table 2 Magnetic properties of dielectromagnets from mixture of melt-spun ribbon Nd-Fe-B alloy - MQP-D and powdered Alnico

Composition	Br kGs	H_{ci} kOe	H_{cb} kOe	$(BH)_{max}$ MGsOe
75 wt.% MQP-D + 25 wt.% strontium ferrite	5,4	8,0	3,2	4,0
50 wt.% MQP-D + 50 wt.% strontium ferrite	4,2	4,0	1,9	1,68
25 wt.% MQP-D + 75 wt.% strontium ferrite	3,3	1,6	1,1	0,72

In the work electroplating method, where coated material is cathode, was used. First experiments with electroplating of dielectromagnets with tin as coating material were done.

The coating films of tin on both kinds of dielectromagnets with strontium ferrite and Alnico are irregular and unequal. In dielectromagnets with strontium ferrite powders, increasing of ferrite contents caused coating film even worse.

The coating layer on dielectromagnets with powdered Alnico is similar to the coating layer of tin. Optical micrographs show the coating layer zones of irregular thickness, but also zones unaffected.

To test influence of electroplating process on magnetic properties of dielectromagnets, magnetic properties were measured after coating with tin. Table 3 shows results of measuring of dielectromagnets from mixed MQP-D and strontium ferrite, table 4 - of dielectromagnets from mixed MQP-D and powdered Alnico.

Table 3 Magnetic properties of dielectromagnets prepared from mixture of MQP-D and strontium ferrite after electroplating with tin

Composition	Br kGs	H_{ci} kOe	H_{cb} kOe	$(BH)_{max}$ MGsOe
75 wt.% MQP-D + 25 wt.% strontium ferrite	4,6	10,9	3,9	4,62
50 wt.% MQP-D + 50 wt.% strontium ferrite	3,0	9,5	2,4	1,82
25 wt.% MQP-D + 75 wt.% strontium ferrite	2,0	5,1	1,6	0,9

Table 4 Magnetic properties of dielectromagnets prepared from mixture of MQP-D and powdered Alnico after electroplating with tin

Composition	Br kGs	H_{ci} kOe	H_{cb} kOe	$(BH)_{max}$ MGsOe
75 wt.% MQP-D + 25 wt.% powdered Alnico	5,3	8,0	3,1	4,0
50 wt.% MQP-D + 50 wt.% powdered Alnico	4,2	3,7	1,8	1,8
25 wt.% MQP-D + 75 wt.% powdered Alnico	3,2	1,6	1,0	0,6

To summary, magnetic properties didn't really change after electroplating process with tin. Influence of this coating process on magnetic properties of both kinds of dielectromagnets didn't find. Comparison of magnetic

properties before and after electroplating shows similar values.

After initial experiments one can suppose that to obtain good quality of coating layer it has to be applied pretreatement of surface and possibly additional transition layer between surface of dielectromagnets and a coating film.

Due to very attractive magnetic properties of dielectromagnets made from mixture of hard magnetic powders it is necessary to continue works on metallic and organic coating films protecting them.

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