

Research article

Influence of additives like saccharin and hydrochloric acid chloride electrolyte for electrochemical deposition of permalloy films

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Abstract

The results of experiments describes on the determination of the composition of the permalloy films and their morphology during electrochemical deposition from chloride electrolyte with the relationship of the content of impurities of iron and nickel in electrolyte corresponding alloy $\text{Ni}_{81}\text{Fe}_{19}$ with additives saccharin and hydrochloric acid. Found that changing the content of saccharin and hydrochloric acid in the chloride electrolyte allows you to adjust the composition of permalloy films and to ensure consistency between the electrolyte composition and films, i.e. films deposition is congruent with the optimal composition. Saccharin in the electrolyte liquid membrane properties shows, regulating the composition and structure of permalloy films.

Keywords: permalloy, electrochemical deposition, chloride electrolyte, saccharin, liquid membrane.

Introduction

According to [1] saccharin promotes formation of three-dimensional nucleation process in a two-dimensional epitaxial matrix early in the deposition of NiFe. This type of process reduces the size of grain nucleation and reduces internal stresses and changes the magnetic properties of the plated films. Number of saccharin is required to change the structure and magnetic properties of NiFe coverage less than 0.06 g/l.

In article [2] examined the effect on growth rate saccharin permalloy films and current effectiveness and shows that these parameters reaches a peak concentration in the electrolyte saccharin 5 g/l. Indicated that the iron content in the film of permalloy decreases with 4.57 percent to 4.45% while increasing the content of saccharin to 9 g/l.

It has been shown previously [3] that additive of hydrochloric acid effect on the pH of the electrolyte and the magnetic properties of permalloy films.

Materials and Method

This article describes the results of experiments on the determination of the composition of the permalloy films and their morphology during electrochemical deposition from chloride electrolyte with the relationship of the content of impurities of iron and nickel in electrolyte corresponding alloy $Ni_{81}Fe_{19}$ [4] and with additives in electrolyte saccharin and hydrochloric acid.

Thickness and morphology of thin films measured by microsystem analyzer MSA-500. The research on the composition of the films was done with the help of PhilipsXL 40 energy-dispersive x-ray micro analyzer.

Results and Discussion

As you can see in Figure 1 the increase of saccharin in electrolytes 12.05; 12.4; 25.10 increases iron content in permalloy films.

As you can see in Figure 1 hydrochloric acid additive in electrolytes 02.12; 09.03 reduces the iron content in permalloy films.

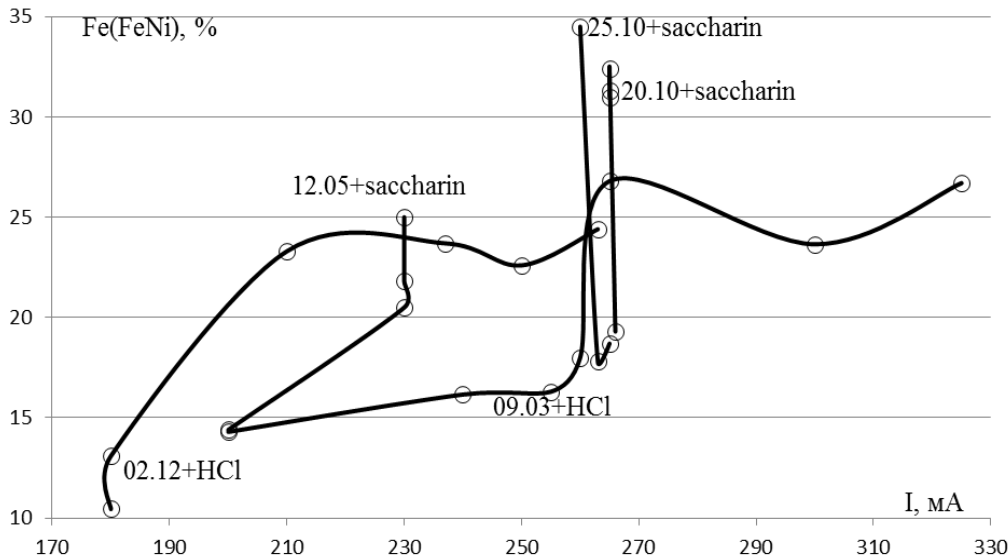


Fig.1: iron content dependence in permalloy films from current electrochemical deposition of chloride electrolytes with the content of iron and nickel, the corresponding alloy $Ni_{81}Fe_{19}$ and marked under the date of manufacture, with subsequent additions of saccharin 3, 6, 9 g/l or hydrochloric acid 2 g/l.

Found that the composition of permalloy films received electrochemical deposition of the electrolyte with the relationship of the content of impurities of iron and nickel in electrolyte corresponding alloy

$\text{Ni}_{81}\text{Fe}_{19}$ depends on additives in electrolyte saccharin and hydrochloric acid. Changing the content of saccharin and hydrochloric acid in the chloride electrolyte the corresponding alloy $\text{Ni}_{81}\text{Fe}_{19}$ allows you to adjust the composition of permalloy films and to ensure consistency between the electrolyte composition and films, i.e. films deposition is congruent with the optimal composition.

[5] the study of the influence of saccharin on the deposition of molecules soft magnetic materials and CoFe shows that at low content of saccharin in the electrolyte of less than 1 g/l to turn on saccharin molecules in deposited film, and at high concentrations, enable considerably reduced because solid film is formed on the surface.

Saccharin film at the cathode is a sieve for iron and nickel atoms, i.e. liquid membrane, providing uniform deposition. A new looks at the role of organic additives in electrolyte meets their action as nuclear membrane in liquid.

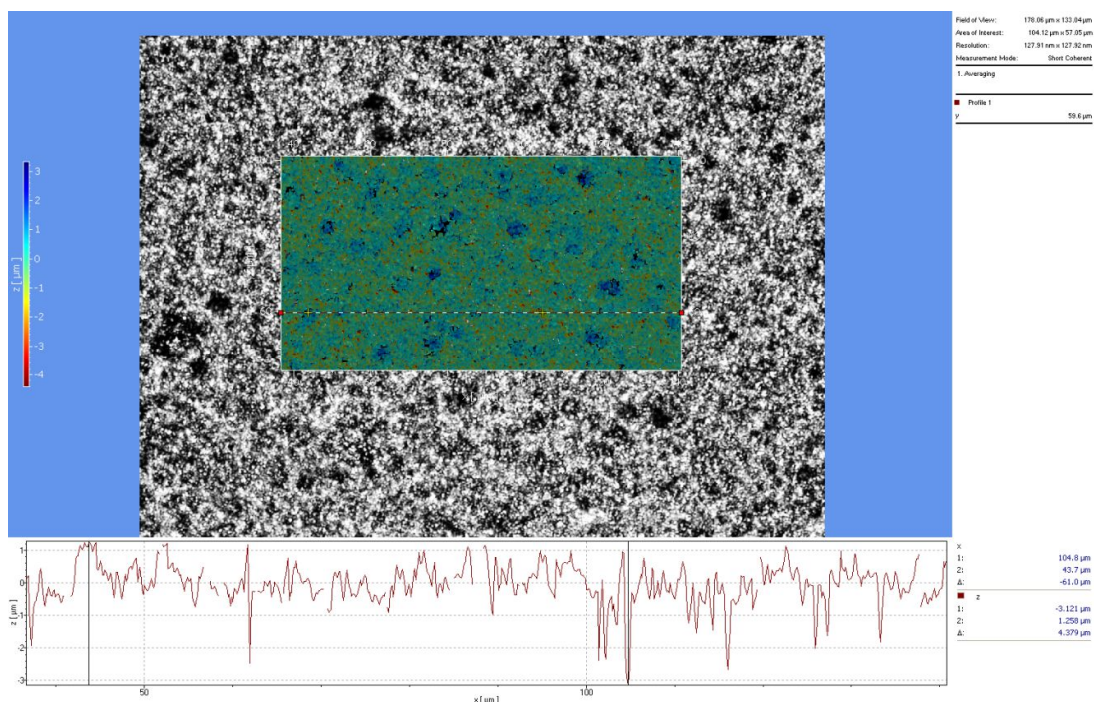


Fig.2:optical microscope photo MSA-500 permalloy films surface with the thickness 6.4 microns in the absence of saccharin in the electrolyte.

The film with iron content of permalloy 19.3% is received from electrolyte 25.10 without saccharin. Structure of films with an average thickness 6.36 μm and range of 5 to 8 μm has kind of needles with length up to 2.2 μm (Figure 2). No saccharin is happening bar crystallization and great irregularity of permalloy deposition. Additive saccharin 3; 6; 9 g/l in the electrolyte increases the speed of film growth 25.10, give iron content up to 32% and flat surface films.

The deposition films are conducted from electrolyte containing 3 g/l of saccharin with perpendicular orientation of the magnetic field of the Earth relative to the surface of the plate. The film surface is smooth and

homogeneous (Figure 3). Film thickness is 11.7 μm and iron content is 17.7%. Morphology element size is order 5 nm.

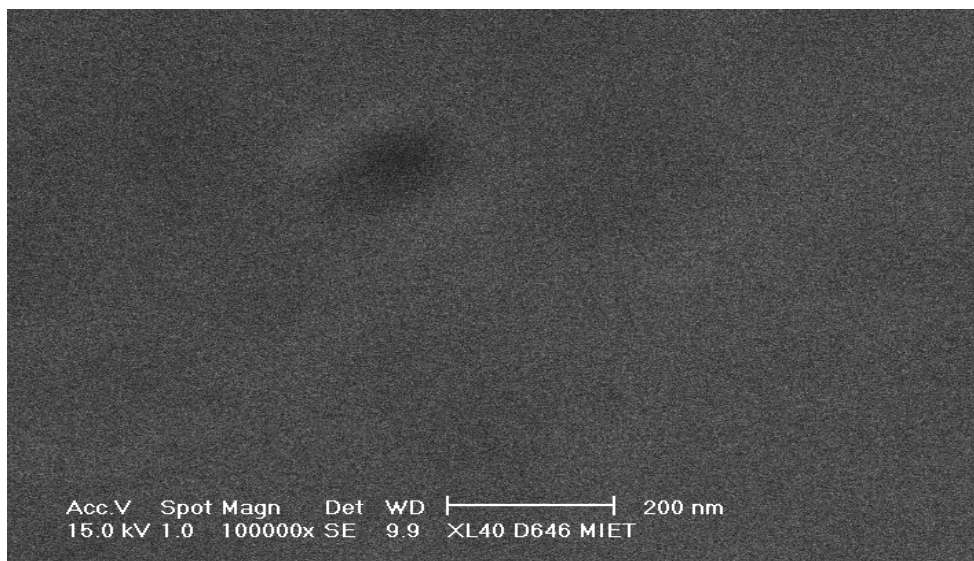


Fig.3- Picture surface permalloy film thickness 11.7 μm on electronic scanning microscope.

The process of deposition of permalloy comes in the form of nucleation process, but not in layers, never by columnar crystallization. It is obvious that education occurs in grains liquid phase involving saccharin as in the supersaturated solution and then the grains are deposited on the surface of the film with a view of the magnetic moments of the grains and the direction of the magnetic field of the Earth.

Conclusion

The conducted researches allow to expense of saccharin content and hydrochloric acid content in the chloride electrolyte regulate the composition of permalloy films to received specified properties. Saccharin in the electrolyte liquid membrane properties shows, regulating the composition and structure of permalloy films during electrochemical deposition. Application of liquid separating membranes separation processes can improve various substances.

In article [6] proposed typing the specified materials to increase selectivity membranes separation. The results obtained in this study suggest avenues for the same purpose use liquid membrane.

Film of permalloy $\text{Ni}_{81}\text{Fe}_{19}$ without mechanical stress and high mechanical strength used [7] composed of integrated microsystems for solving the task of strengthening the magnetic field concentrator located around magnetosensitive items.

Acknowledgments

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