Journal of Korean Institute of surface Engineering
Vol. 32, No. 3, Jun., 1999

CRYSTAL ORIENTATION OF ELECTROLESS COPPER AND ELECTRODEPOSITED NICKEL FILMS ON THE MAGNETS

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Abstract

The deposited Cu film on the ferrite magnet was more deposited comparing with that on the plastic magnet. The Cu film became thicker on the S pole comparing with that on the N pole in the both of magnets. The thickness and texture coefficient of deposited copper film affected with direction of line of magnetic force. The difference of pole had little or no effect to the texture coefficient of deposited nickel film. The reaction rate on ferrite magnet and S pole was faster comparing with that on plastic magnet and N pole.

Key words : *Cu electroless plating, Ni electroplating, Crystal orientation, Magnet.*

1. INTRODUCTION

When electric charged particles moves in a magnetic field, Lorentz force acts to particle at right angle to moving direction. It was concluded that electric field generated, induction dlectric current follows[1),2)]. Magnetic field effects on properties of water were formed energetically at metastable state of water in itself. The chemical and physical properties of electro and electroless deposited metal films affected in the presence of magnetic field[2)]. The relation of plated films and its properties had not studied. Some plating goods on magnets used.

In this work, The effects of direction and angle of magnetic force on the crystal orientation, deposition rate were determined.

2. EXPERIMENT

2. 1 Electroless copper plating

Bath contained 29g/dm^3 $CuSO_4 \cdot 5H_2O$, 140 g/dm^3, and 40g/dm^3 Rochelle salt. An 8cm^3 of 37% HCHO added into 42cm^3 of bath. Bath maintained

at 298k. The ferrite (2.4cm×1.8cm×0.3cm, 1.8mT) and plastic magnet (3cm×2cm×0.5cm, 0.73mT) used. The surfaces rinsed with acetone and air-dried before the experiments.

2. 2 Nickel electroplating

After Cu deposited 3.9㎛ on the ferrite magnet and 1.7㎛ on the plastic magnet, Ni electroplated. Watt's bath contained 250g/dm^3 $NiSO_4 \cdot 6H_2O$, 45g/dm^3 $NiCl_2 \cdot 6H_2O$, and H_3BO_3 30g/dm^3. ph was 5.0. The bath used 150cm^3, and maintained at 323k. The counter electrode used Pt plate (2.5cm ×4.0cm). Current density was 25mA/cm^2, quan tity of electricity was 25C/cm^2. The potential-current curves measured. Working areas of ferrite and plastic magnet were 2.2cm^2 and 3.0cm^2, respectively.

The texture coefficients of deposited film calculated by the equation (1).

$$\text{Texture coefficient} = 100 \times I_{xyz} / (I_{111} + I_{200} + I_{220} + I_{311}) \quad (1)$$

3. RESULTS AND DISCUSSION

3. 1 Electroless copper plating

Fig. 1 shows the effect of temperature on the thickness of deposited film. The thickness increased sharply at 323K. Cu film on the ferrite magnet was more plated comparing with that on the plastic magnet. Fig. 2 shows the effect of deposited time on the thickness of deposited film. The thickness increased with increasing of deposited time. Cu deposited after 30 min on the plastic magnet. It was concluded that the active points, ferrite, on the surface on the plastic magnet was poor comparing with that on the ferrite magnet.

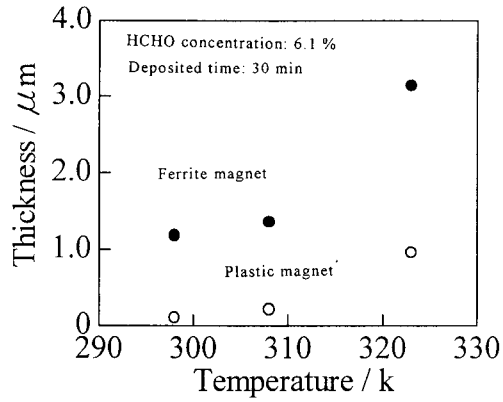

Fig. 1 Effects of temperature on the thickness of deposited copper film Magnet : ● ; Ferrite magnet, ○ ; Plastic magnet, Deposited time: 30 min, HCHO concentration: 6.1%

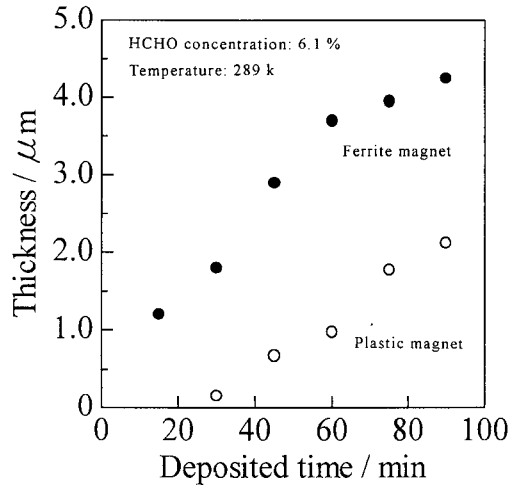

Fig. 2 Effects of deposited time on the thickness of deposited copper film Magnet : ● ; Ferrite magnet, ○ ; Plastic magnet, Temperature : 298k, HCHO concentration : 6.1%

Fig. 3 shows the effect of the HCHO concentration on the thickness. The thickness increased with increasing of HCHO concentration. Thickness maximized at 6% on the ferrite magnet and at 3% on the plastic magnet, thereafter decreased. Table 1 shows the effects of pole on the

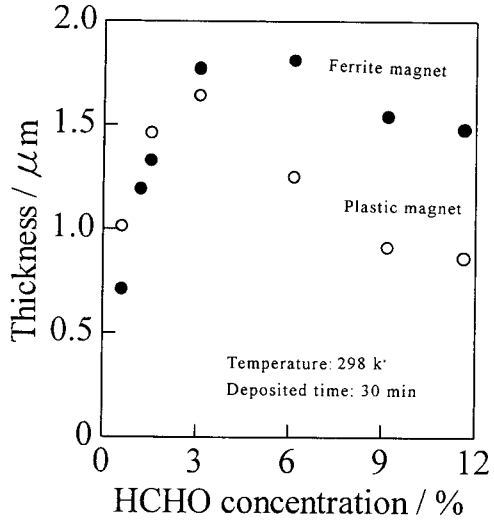

Fig. 3 Effects of HCHO concentration on the thickness of deposited copper film Magnet : ● ; Ferrite magnet, ○ ; Plastic magnet, Deposited time : 30min, Temperature : 298k

Table 1. Effect of poles of magnets on the film thickness

Magnet	Pole	Thickness (㎛)
Ferrite	N	1.70
	S	2.26
Plastic	N	1.45
	S	1.82

1) Ferrite magnet : Deposited time: 30 min, HCHO concentration 6.1%, Temperature ; 298k.
2) Plastic magnet : Deposited time: 75 min, HCHO concentration 6.1%, Temperature ; 298k.

thickness. The film was more deposited on the S pole in comparison with that on the N pole in the both of magnets. It was concluded that deposited rate was affected with the direction of line of magnetic force.

Fig. 4 and 5 show the effects of deposited time on the texture coefficient of deposited film. the order of texture coefficients was the {111} > {200} > {220} > {311} planes on the ferrite magnet. The {111} plane increased with increasing of deposited time. The increasing proportion of the {111} plane on the plastic magnet increased comparing with that on the ferrite magnet.

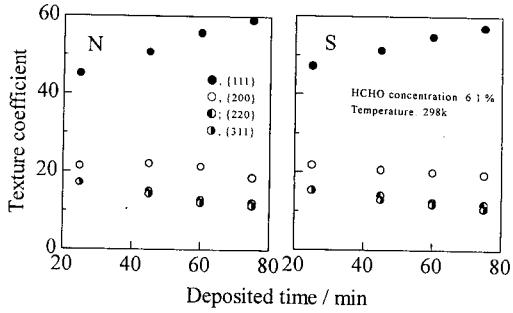

Fig. 4 Effects of deposited time on the texture coefficient of deposited copper film on the ferrite magnet
HCHO concentration : 6.1%, Temperature : 298k

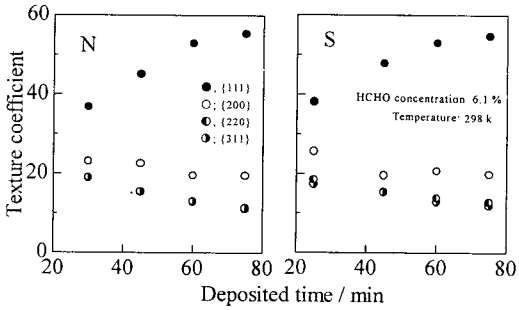

Fig. 5 Effects of deposited time on the texture coefficient of deposited copper film on the plastic magnet
HCHO concentration : 6.1%, Temperature : 298k

Fig. 6 and 7 show the effects of HCHO concentration on the texture coefficients of deposited film. The texture coefficient of the {111} plan maximized at 3% on the N pole and at 1.5% on the S pole, thereafter decreased slowly on the ferrite magnet. It was concluded that texture coefficient of the {111} plane was in the proportion to thickness of deposited film. The texture coeffi-

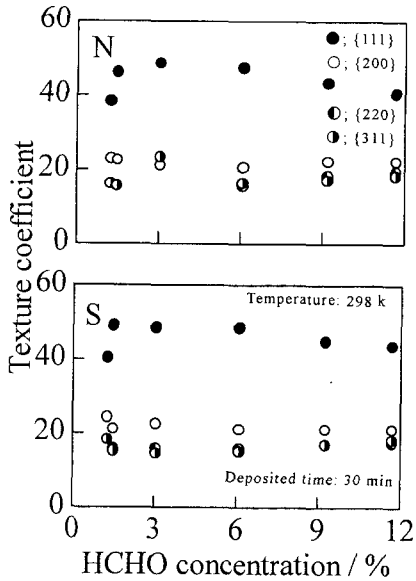

Fig. 6 Effects of deposited time on the texture coefficient of deposited copper film on the ferrite magnet
HCHO concentration : 6.1%, Temperature : 298k

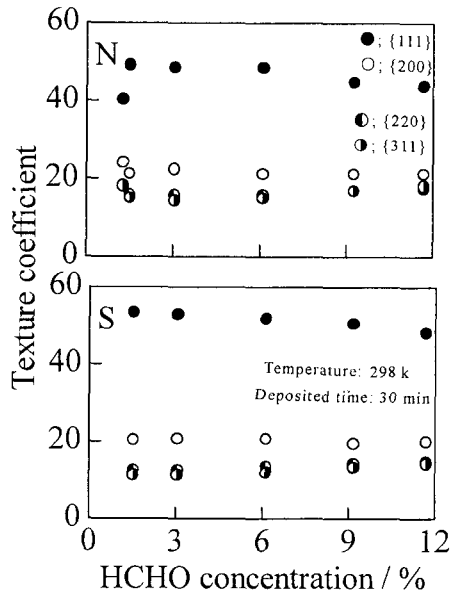

Fig. 7 Effects of deposited time on the texture coefficient of deposited copper film on the plastic magnet
HCHO concentration : 6.1%, Temperature : 298k

cients of deposited film on plastic magnets had little or no effiect with HCHO concentrations and poles of magnet. This reason was not cleared. Table 2 shows the effects of deposited position on the texture coefficients. The texture coefficient of the {111} plane in acenter part was larger comparing with that in the circumference in the both of poles and magnets. It was concluded that the texture coefficients of deposited film affected with the direction of line of magnetic force.

3. 3 Nickel electroplating

Fig. 8 and 9 show the effects of current density on the texture coefficients of electrodeposited film on the ferrite magnet. The texture coefficie-

Table 2. Effect of deposited position of magnets on the texture coefficient

Pole Position		Texture coefficient[1]				Texture coefficient[2]			
		{111}	{200}	{220}	{311}	{111}	{200}	{220}	{311}
N	Center	57.6	19.9	11.6	10.8	53.7	21.2	12.9	12.3
	Circumference	53.3	19.4	13.7	13.6	49.1	21.3	15.5	14.0
S	Center	57.4	19.1	11.4	11.0	54.7	21.3	12.7	11.3
	Circumference	49.2	21.3	15.5	14.0	53.3	19.4	13.7	13.6

[1] Ferrite magnet, Thickness : 3.9㎛
[2] Plastic magnet, Thickness : 1.7㎛

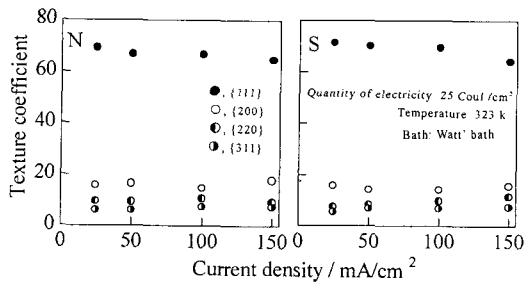

Fig. 8 Effects of current density on the texture coefficient of deposited nickel film on the ferrite magnet
Quantity of electricity : 25 Coul./cm², Temperature : 323k

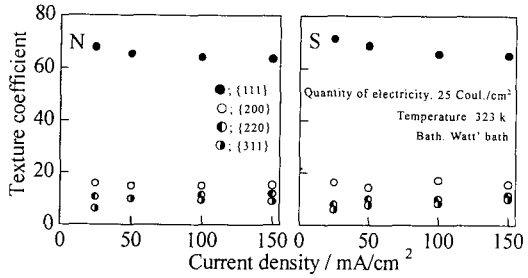

Fig. 9 Effects of current density on the texture coefficient of deposited nickel film on the plastic magnet
Quantity of electricity : 25 Coul./cm², Temperature : 323k

nts were in the order of {111} > {200} > {220} > {311} planes. The {111} plane increased with increasing of current density. The magnetic force and poles had little or no effect to texture coefficients in the both of magnets. Table 3 shows some electrochemical kinetic parameters. Tafel's slope, transfer coefficient and exchange current density changed with the kind of magnets and its poles. Especially, exchange current densities using ferrite magnet were larger comparing with that using plastic magnet. The exchange current densities on the S pole were larger comparing with that on the N pole.

Table 3. Effects of magnet on the Tafel's slope, Transfer coefficient and exchange current density of nickel electrodeposition

Magnet	Pole	Tafel Slope (mV/dec.)	Exchange current density (mA/cm²)	Transfer coefficient (-)
Ferrite	N	65.2	5.80×10^{-5}	0.49
	S	64.1	5.94×10^{-5}	0.50
Plastic	N	58.8	7.41×10^{-6}	0.54
	S	56.2	1.16×10^{-5}	0.57

4. CONCLUSION

1) The deposited copper film on the ferrite magnet was more deposited comparing with that on the plastic magnet.

2) The copper film was deposited on the S pole comparing with that on the N pole in the both of magnets.

3) The thickness and texture coefficient of deposited copper film were affected with direction of line of magnetic force.

4) The difference of pole had little or no effect to the texture coefficient of deposited nickel film. The reaction rate on ferrite magnet and S pole was faster comparing with that on plastic magnet and N pole.

REFERENCE

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