THE TIME PREPARATION INFLUENCE ON THE ELECTRODEPOSITION HARDNESS OF THE COMPOSITE MATERIAL PART II - Ni-P/SiC COMPOUND

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Abstract: To obtain the composite Ni-P/SiC layer were placed in the suspension hard particles of silicon carbide. Percentage of incorporation of the particles is given by the particle volume fraction determined by chemical analysis. Its value was obtained by dividing the total volume of particles with one particle volume and is well determined if the particles have a definite shape and size distribution and has a well-dispersed and within strict limits. Increased content of hard particles gives the amount of particles deposited per unit of surface layer and the amount of hard particles codeposited is not constant throughout the composition. This phenomenon is particularly striking as the hard particles concentration in the electrolyte is higher.

1. INTRODUCTION

In part I of the paper we studied the variation of hardness of Ni-P alloy electrodeposited on copper layer. Because working conditions affect electrodeposition was studied the influence of time to develop the material hardness Ni-P. To obtain the composite Ni-P/SiC layer were placed in the suspension hard particles of silicon carbide [1]. Percentage of incorporation of the particles is given by the particle volume fraction determined by chemical analysis [2]. Its value was obtained by dividing the total volume of particles with one particle volume and is well determined if the particles have a definite shape and size distribution and has a well-dispersed and within strict limits. Increased content of hard particles gives the amount of particles deposited per unit of surface layer and the amount of hard particles codeposited is not constant throughout the composition. This phenomenon is particularly striking as the hard particles concentration in the electrolyte is higher.

For deposits with high hard particle quantity surface saturation starts at lower content of phosphorous acid. For deposits with a lower concentration of hard particles that saturate of particles per unit mass is lower, but still noticeable.

2. EXPERIMENTAL PART

As in alloy electrodeposited Ni-P composite coatings the material composite layer were obtained in the electrolysis cell shown in figure 1.

Silicon carbide used to develop composite layers has the following characteristics: purity of 99,9%; size of about 1μm, specific surface area of 10,4m^2/g, the main impurities: iron: 0,03%, aluminum: 0,02 % vanadium: 0,02%. Figure 2 shows a micrography (SEM) of silicon carbide particles.

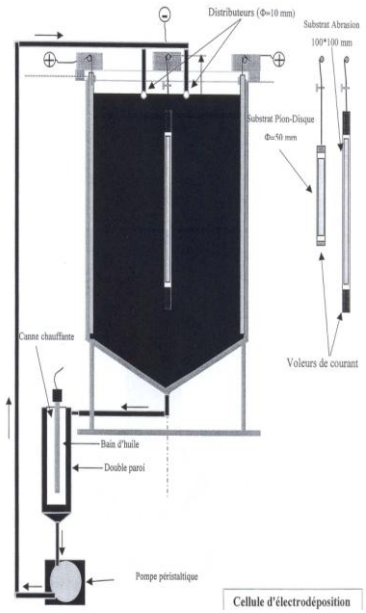

Figure 1: Electrolysis cell

The support that have made deposits is electrolytic copper with purity of 99.9%, hardness of 100 Hv, and the thickness of the discs where were depositet the composite layers was 3 mm. Ni-P/SiC composite electrodeposition were obtained as the electrodeposited layers of the part I of the paper by varying development time (10-40 min), and the electrolyte has a content of 20 g / l H_3PO_3 and 80 g / l SiC.

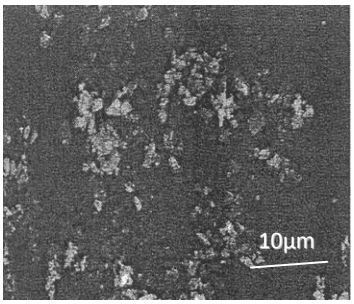

Figure 2: Micrography (SEM) of silicon carbide particle

By varying development time were obtained layers with variable thicknesses (Table 1), where: PS1 is the deposition obtained in 10 min, PS2 is obtained in 20 min, PS3 is the deposition obtained in 30 min and PS4 is the deposition obtained in 40 min.

Table 1. Thickness measured samples

Layer	PS1	PS2	PS3	PS4
Measured average thickness (µm)	4,9	9,8	28	59

Variation of hardness deposits on the time development is shown in Figure 3. Vickers hardness was measured using laboratory microdurimetrului "Shimadzu HMV-2" and tasks that were performed attempts were 25g, 50g, 200g, 500g, 1000g, 2000g driven perpendicular to the surface layer.

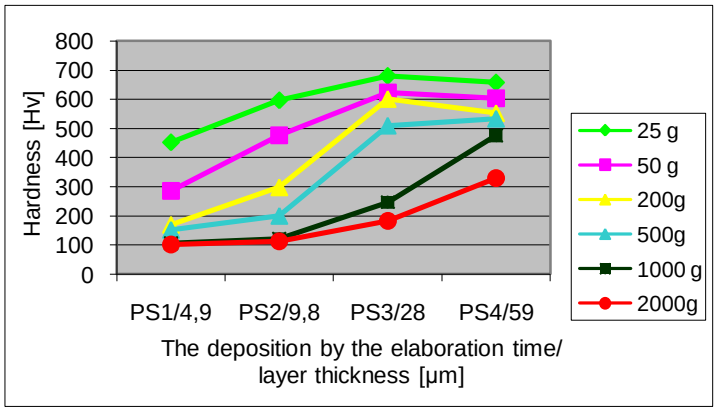

Figure 3: Dependence of the hardness codepositions by the time of elaboration, layer thickness and applied load

The curves in Figure 3 shows that hardness increases linearly and significantly at the application tasks 25g, 50g, 200g, 500g for the samples obtained within 10 min - 30 min. For the sample developed during the higher time, for the same tasks, hardness decreases slightly. At the 1kg and 2 kg load, hardness is almost constant for PS1 and PS2 samples, increasing significantly for PS3 and PS4. However, for the same film thickness, hardness obtained decreases as the applied load increases. By using loads up to 500g, the hardness layers do not vary greatly, which could mean that in this case the substrate does not occur, and the measured coating hardness is only NiP / SiC hardness. For 1000g and 2000g loads, hardness decreases significantly having an increasing development once with thickness increasing.

Significant reduction of hardness when using heavy loads shows that in this case copper substrate comes with an increasingly percent in the measured hardness value. We can say therefore the measured hardness is not the intrinsic hardness of the layer but becomes the composite material hardness consisting of substrate and deposition.

Determination of the deposited layers allowed the fingerprints diagonals measurement left by the penetrator, and their values are listed in table 2.

Table 2. Diagonals fingerprint at the PS1, PS2, PS3, PS4 application loads

Layer	Load [g]					
	25g	50g	200g	500g,	1000g	2000g
	D_{med} (µm)					
PS1	11,4	18	34,4	82,6	134,3	196,1
PS2	8,5	12,6	33,9	78,3	131,4	192,2
PS3	8,2	12,2	29,6	68,5	109,5	164,3
PS4	7,3	12	26,9	55,2	81,5	123,9

Because tasks were applied perpendicular to the surface layer, we apply the relationships established between diagonal footprint left by the penetrator from these tasks and thickness (relations 1-7 from Part I of the paper). For tests that verify the 7 relationship, the Hays-Kendall model can be applied [3], otherwise it will check the analytical models for composite materials, Buckle [4] and Jönsson - Hogmark [5].

3. CONCLUSIONS

Hardness tests conducted on composites obtained by varying the time of development shows that this size depends on the applied load. At light loads, for the same film thickness, hardness obtained decreases as the applied load increases and when layer

is thicker the hardness is greater. At high loads the hardness layer decreases significantly, indicating the influence of the support. Thus, the measured hardness is not the intrinsic hardness of the layer, it becomes a material hardness of the composite substrate and deposit. By measuring the diagonals of the fingerprint and by the relationships that characterize the application loads perpendicular to the surface layer ($d \leq 4{,}55 \cdot h_s$) Hays-Kendall model has been verified that effect, that agree microhardness task dependence (DSM) penetration with the law Kick[6] admitting that measured hardness must be independent of applied load of the penetrator.

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