B. OLEKSIAK, G. SIWIEC, A. KRABES, M. BOBER

ISSN 0543-5846
METABK 58(3-4) 272-274 (2019)
UDC – UDK 542.8:739.1:621.793.002.61:538.55-531.75:620.178.1=111

RESEARCH ON ELECTROCHEMICAL SILVERING PROCESS OF BRASS ELEMENTS

Received – Primljeno: 2018-09-24
Accepted – Prihvaćeno: 2019-01-10
Preliminary Note – Prethodno priopćenje

In the presented paper the authors attempted at analyzing the selected properties of silver coatings processed with electrochemical method on brass elements. The conducted research indicates that changes in cathode current density in the range 100 A · dm^{-2} to 333 A · dm^{-2} and the process time in the range of 60 s to 120 s have no effect on the basic properties of the obtained silver coatings (microhardness, corrosion resistance, adhesion), but it only seems to affect their appearance.

Key words: galvanizing, silver coatings, coating properties, current density, microhardness

INTRODUCTION

Silver coatings applied on metals or alloys with electrochemical methods find a number of applications. It is determined not only by attractive appearance of the coated elements, but also by their favorable mechanical properties such as high electrical conductivity or corrosion resistance. They are used in automotive industry, electrical engineering, chemical industry, jewelry making and musical instruments manufacturing industry [1 - 4].

In the presented paper the authors attempted at analyzing the selected properties of silver coatings processed with electrochemical method on brass elements.

RESEARCH METHODOLOGY

In the silver coating process the QUASAR galvanizer was used. The main components of the galvanizing bath were silver cyanide, potassium cyanide and antimony fluoride. Brass plates and brass mouthpieces of brass musical instruments were used in the research. A detailed description of the research methodology is presented in [5]. The parameters of the process of silver coatings application on the surface of brass sheets are presented in Table 1.

In order to determine the properties of the obtained coatings, the samples were subjected to microhardness testing performed on the Future-Tech Corp microhardness tester integrated with an automatic measuring table, computer and metallographic microscope which enables Vicker's hardness (HV) measurement. The microhardness measurements were taken at 12 different points of the tested surface of each sample. In order to check the adhesion of silver coatings to substrate the chamber furnace preheated to 573 K was used. There, the sheets were heated for 60 seconds and then rapidly cooled in water. However, in order to check the corrosion resistance of the coating to human saliva, the effects of synthetic saliva was observed for 24 hours.

Table 1 **Parameters of galvanizing process**

Simple No	Time / s	Cathode current density / A·dm^{-2}
1	30	200
2	60	200
3	90	200
4	120	200
5	120	250
6	90	250
7	60	250
8	30	250
9	120	333
10	90	333
11	60	333
12	30	333
13	120	100
14	90	100
15	60	100
16	30	100
17	30	200

TEST RESULTS

Figures 1 - 2 show sample images obtained with the use of metallographic microscope during microhardness measurements, Figure 3 shows the average microhardness values for the selected samples, while the microhardness distribution over the entire length of samples 11 and 17 can be seen in Figures 4 and 5.

B. Oleksiak: Beata.Oleksiak@polsl.pl, Silesian University of Technology, Katowice, Poland
G. Siwiec, Silesian University of Technology, Katowice, Poland,
M. Bober ElektroCarbon-Galwan, Tarnowskie Gory, Poland

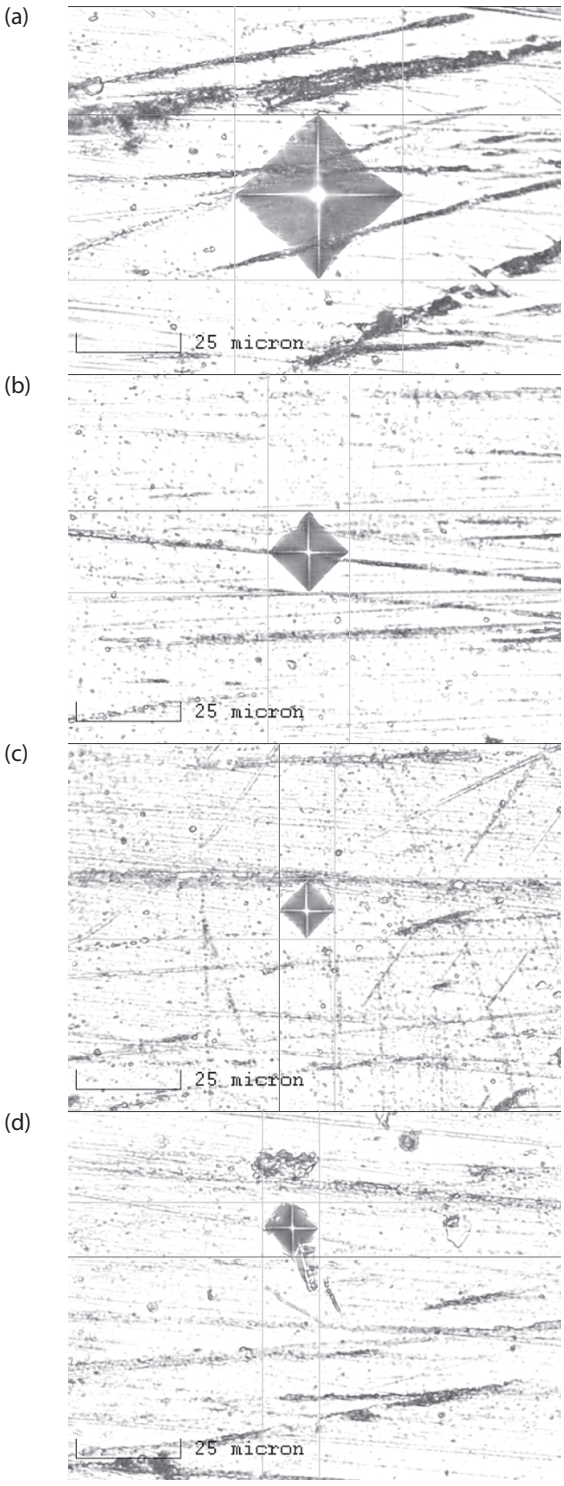

Figure 1 Microstructure in the hardness measurement area of sample 3: a) coating microstructure at point 1 with a visible impression, 117 HV0,1; b) coating microstructure at point 7 with a visible impression, 145 HV0,1; c) coating microstructure at point 10 with a visible impression, 153 HV0,1; d) coating microstructure at point 12 with a visible impression, 167 HV0,1

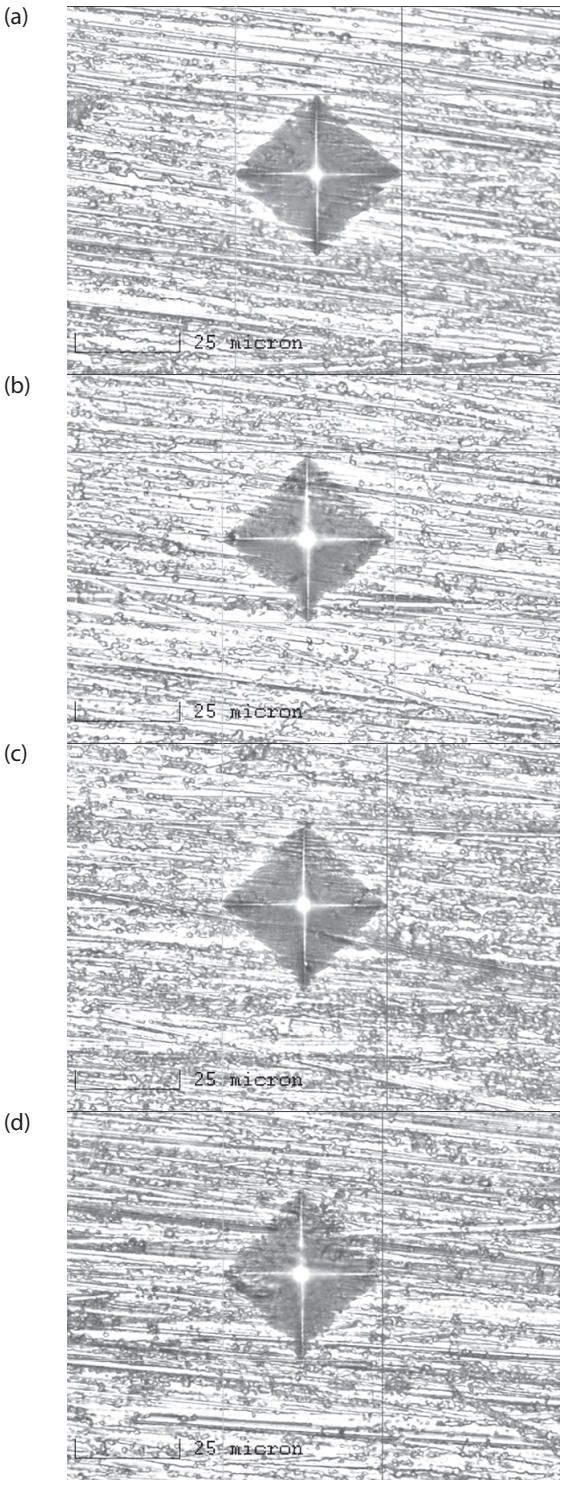

Figure 2 Microstructure in the area of hardness measurement of sample 17: a) microstructure at point 1 with visible impression, 121 HV0,1; b) coating microstructure at point 7 with a visible impression, 111 HV0.1; c) coating microstructure at point 10 with a visible impression, 114 HV0,1; d) coating microstructure at point 12 with a visible impression, 118 HV0,1

Adhesion tests of coatings to substrate as well as their resistance to human saliva indicated, in all cases, good quality of the obtained silver coatings. Consecutively, the results of microhardness tests indicate marginal impact of the parameters of silvering process upon its value. On the other hand, the silver coating obtained at a cathode current density of 100 A • dm-2 during 60 s (sample No. 17) was characterized by the most attractive appearance. Therefore, the above mentioned parameters were used for the silvering process of mouthpieces for brass wind instrument. The mouthpieces after silver coating application are shown in Figure 6.

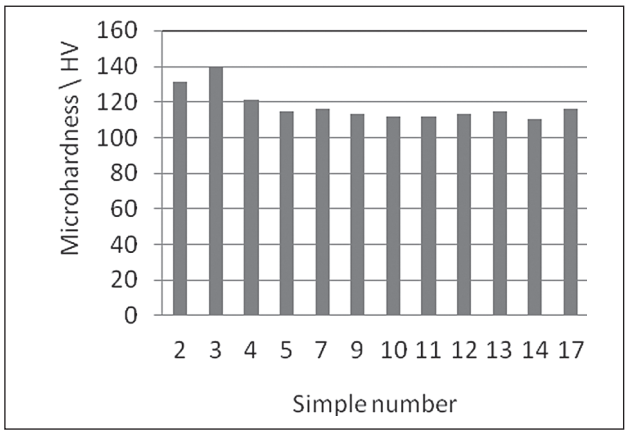

Figure 3 Microhardness of brass sheets.

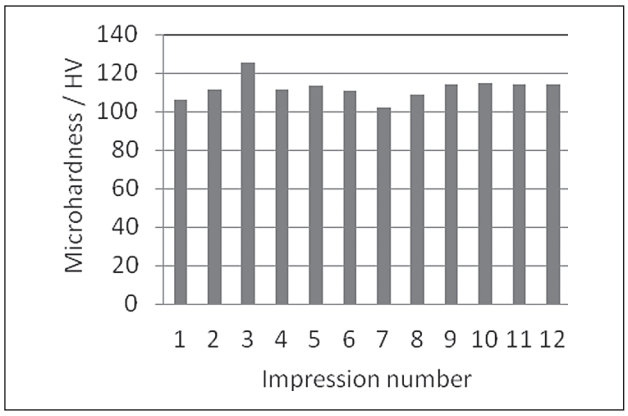

Figure 4 Microhardness for each separate number of sample impression 11

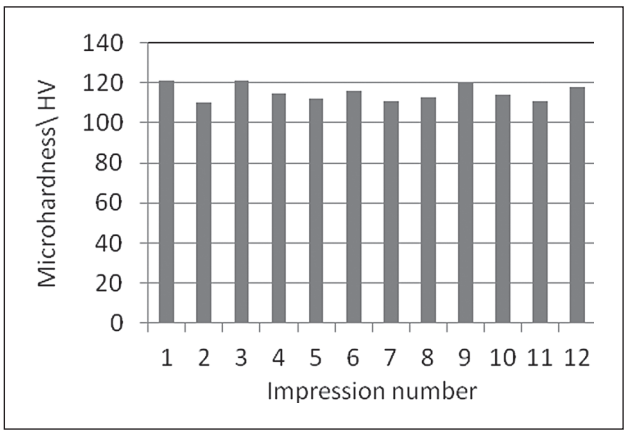

Figure 5 Microhardness for each separate number of sample impression 17.

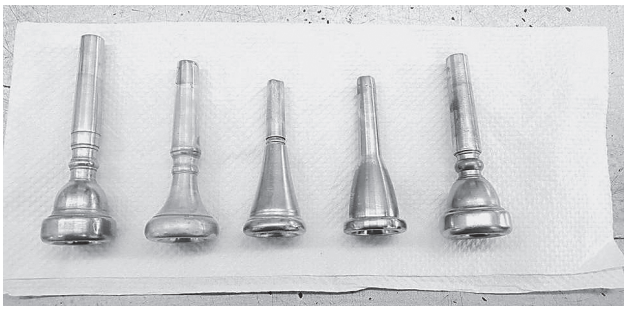

Figure 6 Mouthpieces after silvering process application

The studies on the adhesion of coatings to substrate and their resistance to human saliva, in case of mouthpieces of brass musical instruments covered with a layer of silver, confirmed the good quality of the obtained coatings.

SUMMARY

The research carried out on the process of silver coatings application on the surface of brass elements with the electrochemical method allows to obtain layers of good adhesion to the substrate and resistant to the impact (corrosion) of human saliva. Their additional advantage is even distribution of microhardness values along the entire length of the samples and their attractive appearance. Therefore, it is possible to implement successfully this type of technique for covering brass wind instrument mouthpieces, with the cathode current density at 100 A $\cdot dm^{-2}$ and short process times (of the order of 60 s). The conducted research indicates that changes in cathode current density in the range 100 A $\cdot dm^{-2}$ to 333 A $\cdot dm^{-2}$ and the process time in the range of 60 s to 120 s have no effect on the basic properties of the obtained silver coatings (microhardness, corrosion resistance, adhesion), but it only seems to affect their appearance.

REFERENCES

[1] Hryniewicz T.: Surface and coating technology, Publisher of University of Technology, Koszalin (2004).
[2] Żak T., Kolanko Z., A guide to galvanic engineering, Scientific and Technical Publishing, Warsaw (1985).
[3] Godzsak M., Levai, G., Vad, K., Csik, A., Hakl, J., Kulcsar, T., Kaptay, G., Coloring hot-dip galvanization of steel samples in industrial zinc-manganese baths, Journal of mining and metallurgy section b-metallurgy 53 (2017) 3, 319-326.
[4] Wańkowicz-Lis A., Oleksiak B., Siwiec G., Wieczorek J., Tomaszewska A., Decorative metallic coatings applied with galvanic method, Metalurgija 57 (2018) 3, 165-167.
[5] Hendrich H. D., Studes on mass galvanization, Galvanotechnik 71 (1980) 1, 43 - 44.

Note: Krajewska T. is responsible for English language, Katowice, Poland