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RESEARCHES REGARDING THE STRUCTURE INVESTIGATIONS ON NEW MATERIALS OF THE COMPOSITE TYPE

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Lucrarea de față prezintă rezultatele cercetărilor metalografice la materiale noi, cu proprietăți îmbunătățite, compozite utilizate în fabricarea sau renovarea unor părți ale lagărelor .Investigarea componentelor a fost realizată atât prin microscopie optică, cât si microscopie electronică, utilizând materiale compozite şi metal la interfață între substrat şi materialul metalic. Rezultatele structurale recomandă utilizarea de astfel de material.

Paper presents the results of metallographic investigations on new materials with enhanced properties, the composite used in the manufacture or refurbishment of parts of the component bearing. Investigations have been conducted both by optical microscopy, and by the electronics, using both composite and metallic materials interface between them and the base material which is coated. Structural aspects results recommend the use of such material.

Keywords: composite materials, structure, properties

1. Introduction

Research and experiments conducted have sought to establish definitive technology for obtaining parts covered with composite materials by thermal spraying [1]. We have studied the composition of the sliding bearings of parts that were composites metalized OL (40Cr130) + Al, Al + Bz (CuSn6). The process used for metallization is called metallization with electric arc [9] using Arc Spray 4[10].The deposition were been made on support probes (Ø30x10mm), from the ferrite-pearlitic unalloyed steel mark S355J2G2 (EN 10025+Al). The OL (40Cr130), Al 99, 8 % and Bz (CuSn6) are 3 wires which are consider first as a couple OL+Al wires and second Al+Bz (CuSn6) couple for metallization [4]. The wire OL (40Cr130) is alloyed steel type 40Cr130, Al 99, 8% and Bz (CuSn6).

These three wires used for metallization have 1.6 mm diameters and the values of the parameters used for metallization are I=50A, U=30 V, p = 5 bar and

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distance of spraying d= 170 mm. Surface preparation for coating metallization was done electro-corundum.

Quality control surface after blasting was done visually according to EN ISO 8501-3, following the matte surface, uniform, completely devoid of physical impurities (oxides, salts, paint, and so on)[11]. The layer step it will be subjected to metallographic investigations.

Metallographic investigations [2] consisted of:

a. Optical microscopy;
b. Electrical microscopy.

a. <u>Optical microscopy investigations have followed:</u>

- *Structure* of the metallic layer thickness (highlighting inclusions and pores);
- *Thickness* of the composite metallic layer;
- *Metallic* morphology of the composite compound layer;
- *Microstructure* of the layer at the interface.

For optical microscopy was used Reichert microscope [8] with optical analysis software, equipped with video camera image processing, interface and software for quantitative analysis Buehler. For electron microscopy was used electronic microscope of type ESEM XL -30 FEI (Philips)[3]. For an exact determination of the metallic compound layer thickness variation, on all samples were performed 24 measurements of thickness of metallic layer at equal intervals along a length of 8.5 mm [4]. The resulted data of the measurements were statistically processed.

2. Metallographic Investigations

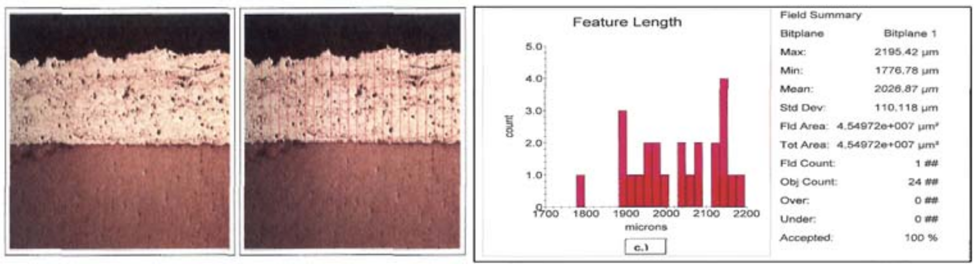
a.1.Investigations on the structure and optical metallography metallic layer

In Fig..1.1 (a, b, c) are presented optical micrographic, captured and processed, composite material layer OL + Al and metallic layer thickness distribution [5].

It can be noted the presence of inclusions and structure of small pores. To determine the exact thickness changes were made 24 metallic layer thickness measurements at equal distances, a distance of 8.5 mm, as can be seen in fig.1.1 b).

The statistical processing of data derived from measurements lead to the following results - the average thickness of the layer is 2.026 mm, minimum thickness of 1.776 mm and a maximum of 2195 mm. Graph 1.1 c) shows histograms thickness variation.

Proof: bearing an Objective: 2x
Material: OL + Al Calibration: 4.86790 [jm / Pixel]

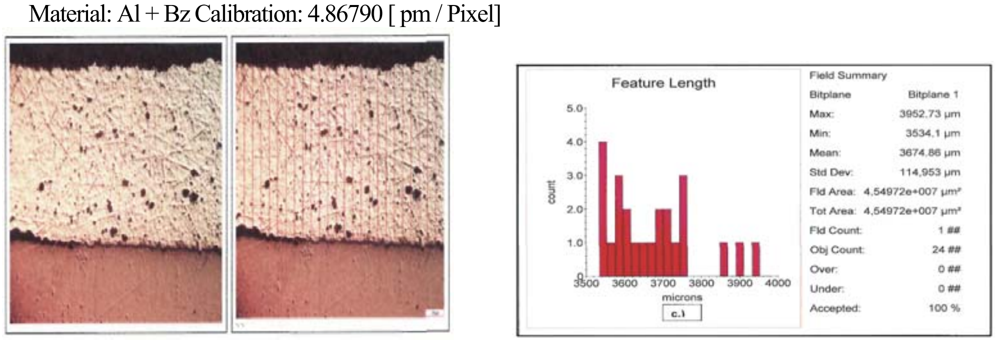


Capturated image Processed image
a) b) c)

Fig.1.1. Optical micrographic layer composite of OL + A1 and metallic layer thickness distribution.

In Fig. 1.2 (a, b, c) are presented optical micrographic, captured and processed, a layer of metallic material and composite Al + Bz metallic layer thickness distribution.

Proof: bearing 2 Objective: 2x
Material: Al + Bz Calibration: 4.86790 [pm / Pixel]



Captured image Processed image
a.) b.) c.)

Proof: Bearing 2 Objective: 2x
Material: Al + Bz Calibration: 4.86790 [pm / Pixel]

Fig.1.2. Optical micrographic of the layer composite material Al + Bz and thickness distribution of metalized layer

In Fig..1.2 a) are presented the optical micrography of the metallized layer from which results it's thickness[6]. It can be observed the presence of some relative big pores in the structure. For exact determinations of the metallized layer thicknes variation, have been made 24 measurements of the thickness of metallic layer at equal distances, on a distance of 8.5 mm, as seen in fig.1.2 b). From the statistical processing of data results that the average thickness of the layer is 3.674

mm, 3.534 mm is the minimum thickness and 3.952 mm is the maximum. Graph 1.2 c) shows histogram thickness variation.

a.2 Investigations of optical metallography on the morphology and microstructure of composite metallic layer at the interface layer.

Fig. 1.3 a, b) shows metallic composite layer morphology of OL + Al. It can be observed that the structure is relatively uniform and presents pores and possible inclusions [7]. Also, presents micrographic layers at the interface between composite and base metallic material.

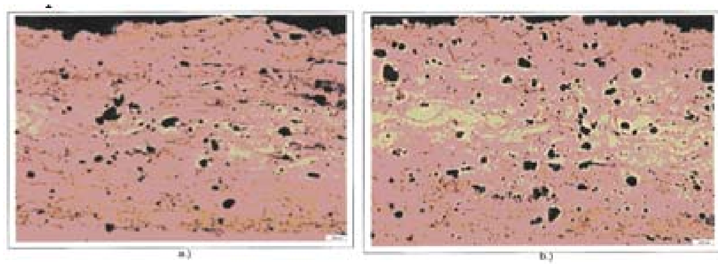


Fig.1.3 a,b). Morphology of composite metallic layer OL + A1 (a) and the interface of basis metallic material (b).

It can be seen in the fig.1.3 a.b, a good adhesion between the composite metalic material and the metalic base material.

Fig. 1.4 a), shows the morphology of the metallized layer composite Al+Bz, from which it observed that the stucture is uniform and presents few and rare pores.

Fig. 1.4 b), shows interface microstucture between metallize composite layer and base metalic material.

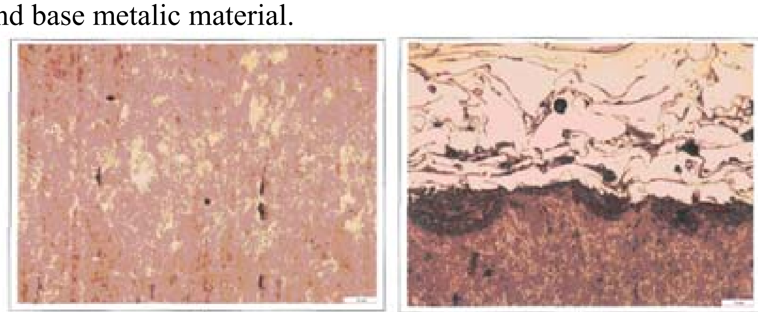


Fig 1.4 . Morphology of metallized metallic composite layer Al+Cu (a) and of the interface with the base metal material (b).

From Fig. 1.4 it can be observed a low adhesion betweent the two layers. The electronic microstructural investigation of the metallized layer on bearings.

Fig. 1.5 presents the image composition of OL + Al composite metallic layer, consisting of four sections, at a magnification of 200x.

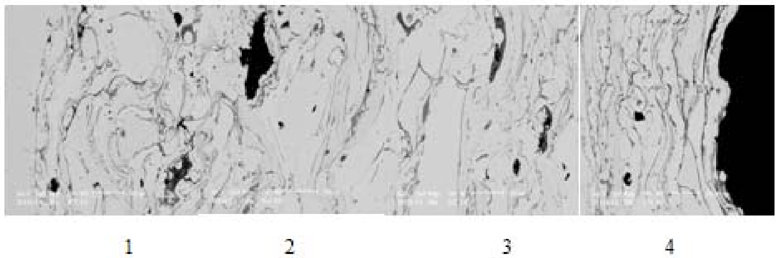
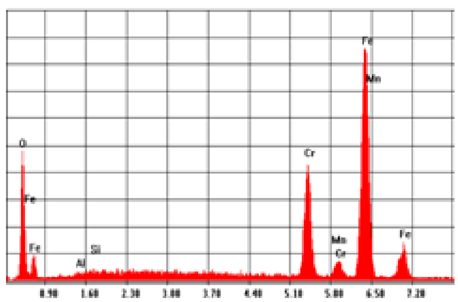


Fig.1.5. The image composition of OL-Al metallic composite layer consists of four sections. 200x

From the analysis of composed image it can be noticed the presence of some inclusions of black and gray color in the metallized layer.

Fig. 2.1 shows the chemical compositions of the filiform inclusions in the metallized layer.

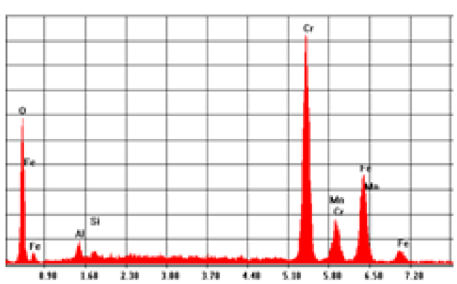


Element, Wt %, At %,
O K, 16.01, 39.33,
AlK, 0.40, 0.58,
SiK, 0.41, 0.57,
CrK, 18.75, 14.17,
MnK, 1.24, 0.88,
FeK, 63.19, 44.46,
Total, 100.000,

Fig. 2.1. The chemical composition of filiform inclusions from metallic layer.

From analysis of this figure can be observed the inclusions of oxides, iron and chromium, which are in the structure of the metallized metallic layer.

Fig. 2.2 presents the chemical composition of inclusions of gray metallic layer.

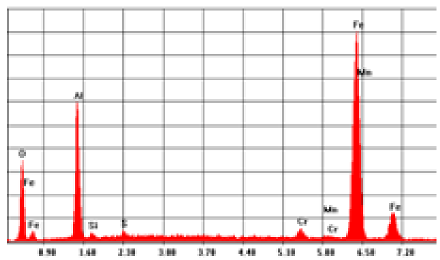


Element, Wt %, At %,
O K, 20.69, 45.68,
AlK, 2.12, 2.77,
SiK, 0.91, 1.14,
CrK, 45.20, 30.70,
MnK, 4.73, 3.04,
FeK, 26.36, 16.67,
Total, 100.000, 100.000

Fig. 2.2. The chemical composition of the gray inclusions, from metallic layer.

The analysis of this figure in conjunction with chemical composition shows that gray inclusions are composed of chromium and iron oxides.

Fig. 2.3 presents the chemical composition of inclusions in the substrate.

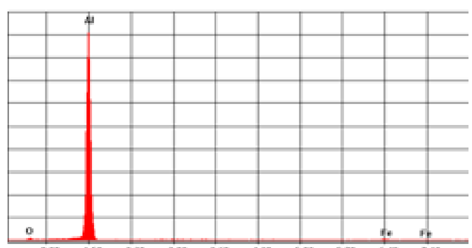


Element,	Wt %,	At %,
O K,	15.23,	33.74
AlK,	16.91,	22.21,
SiK,	0.87,	1.09,
S K,	0.79,	0.87,
CrK,	1.78,	1.21,
MnK,	0.87,	0.56,
FeK,	63.55,	40.31
Total,	100.000,	

Fig. 2.3. Chemical composition of inclusions in the substrate.

From the analysis of this figure it can be noticed that in the substrate there are some inclusions of iron and aluminum.

Fig. 2.4 shows the chemical composition of the black and gray inclusions from the metallized layer.

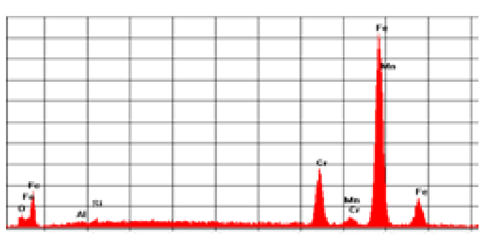


Element,	Wt %,	At %,
O K,	5.10,	8.41
AlK,	92.50,	90.4
FeK,	2.40,	1.13,
Total,	100.000,	

Fig.2.4. Chemical composition of black inclusions, in the layer.

By analysis of this figure it can be observed the presence in layer of some inclusions of black color, formed from aluminum oxides.

Fig. 2.5 shows the chemical composition of metallized layer.



Element,	Wt %,	At %,
O K,	2.87,	9.11
AlK,	0.85,	1.60,
SiK,	0.96,	1.74,
CrK,	14.34,	13.99,
MnK,	0.82,	0.76,
FeK,	80.15,	72.80,
Total,	100.000,	

Fig.2.5.Chemical composition of metallize layer.

From analysis of this figure it can be observed the presence of some inclusions of iron and chromium.

In Fig. 2.6 shows the composition image of the metallized composite layer Al+Bz.

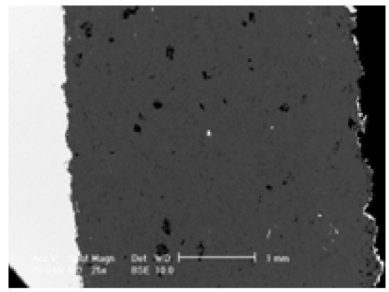
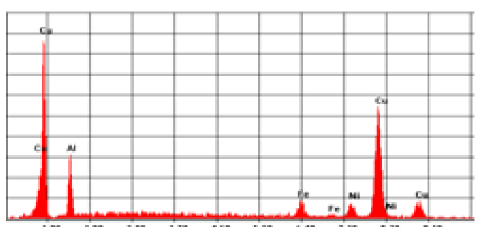


Fig. 2.6. The image composition of metallic composite layer Al + Bz. Magnification 25x.

From analysis of image composition was found the presence in the exterior of metallized layer, of some inclusions of white formations and the presence at the interface of some black particles and also in the metallized layer the presence of some dark gray, gray and white particles.Fig. 2.7 shows the chemical composition of inclusions of white particles from metallized layer.



Element, Wt %, At %,

AlK, 11.73, 23.57,
FeK, 4.72, 4.59,
NiK, 7.51, 6.94,
CuK, 76.04, 64.90,
Total, 100.000, 100.000

Fig. 2.7. Chemical composition of inclusions from the metallize layer found in form of white particles

From analysis of this figure it can be found that the white particles which are in the metallized layer contain,basically Cu and Al.

3. Conclusions

The experimental investigation confirms the possibility of obtaining OL+Al , Al+Bz composites by leading to a new corresponding realization of microstructures with mechanical and special physico-chemical properties different from the starting material used for metallization. These composites can be used to fabricate new components or to repair used components, working in hard conditions.

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R E F E R E N C E S

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