INVESTIGATION OF THE SELECTED PROPERTIES OF SUPERFICIAL LAYER ALLOYING WITH THE TUNGSTEN ELECTRODES

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Abstract

The paper presents a brief study of micro electro spark deposition with using an tungsten electrode. The electrical-discharge alloying with wire electrodes (WEDA) is a machining method performed on EDM machine with using elastically wire electrode such as alloying electrode. Electrode is being made of material which is to be alloyed on the part surface. Attention has been paid to the possibilities of applying hybrid alloying (electrical discharge deposition with mechanical interaction) as a surface improvement process for complex shape parts. The anti-wear coatings were applied on carbon steel C45 with using micro electrical discharges between alloying surface and universal wire electrode. Special attention has been paid to the possibilities of applying mentioned method to increase abrasive wear resistant of tools such as injection moulds and machine parts. Evaluate the elements distribution in the superficial layer. The depth of alloying layer ranges to hundreds micrometers. The alloying with tungsten electrode the layer of large tungsten share constituted. The results of investigations showed that there is a possibility of obtaining the satisfying quality joint between the carbon steel C45 and tungsten layer.

Keywords: Micro electrical-discharge alloying, micro electro spark deposition, superficial layer, microstructure, micro-hardness

1. INTRODUCTION

Due to the present trend in constructing machines, alloys of special properties are often used. These materials are characterised by mechanical durability and high resistance to abrasion and corrosion. The production of whole structures is associated with high costs, therefore often the superficial layer is modified.

There are many methods of modification of the superfical layer, one example of such a treatment may be electrical sparc deposition (ESD). Electrical spark deposition is a pulsed arc microwelding process using short duration pulses, to deposit an electrode material on a metallic substrate. It is one of the few methods available by which a fused, metallurgically bonded coating can be applied with such a low total heat input that the bulk substrate material remains at or near ambient temperatures. The short duration of the electrical pulse allows an extremely rapid solidification of the deposited material and results in an exceptionally fine grained, homogeneous coating that approaches (and with some materials, actually is), an amorphous structure.

The electrospark deposition process is used to improve wear performance and corrosion resistance of metal surfaces. The tungsten was selected as an electrode, is deposited on a steel (C45) substrate in the ESD process experiments. Some technological parameters of coating, such as roughness were investigated.

2. EXPERIMENTAL PROCEDURE AND RESULTS

2.1. Structure investigation after ESD

To presents the results of investigating electrical spark deposition traces on the machined surface single discharge was capture and present on **Fig. 1**. The tests were performed on scanning profilometer which can not only give visual information on the shape of discharge traces but also enables measurement of trace geometry and give information on volume of pits and flashes.

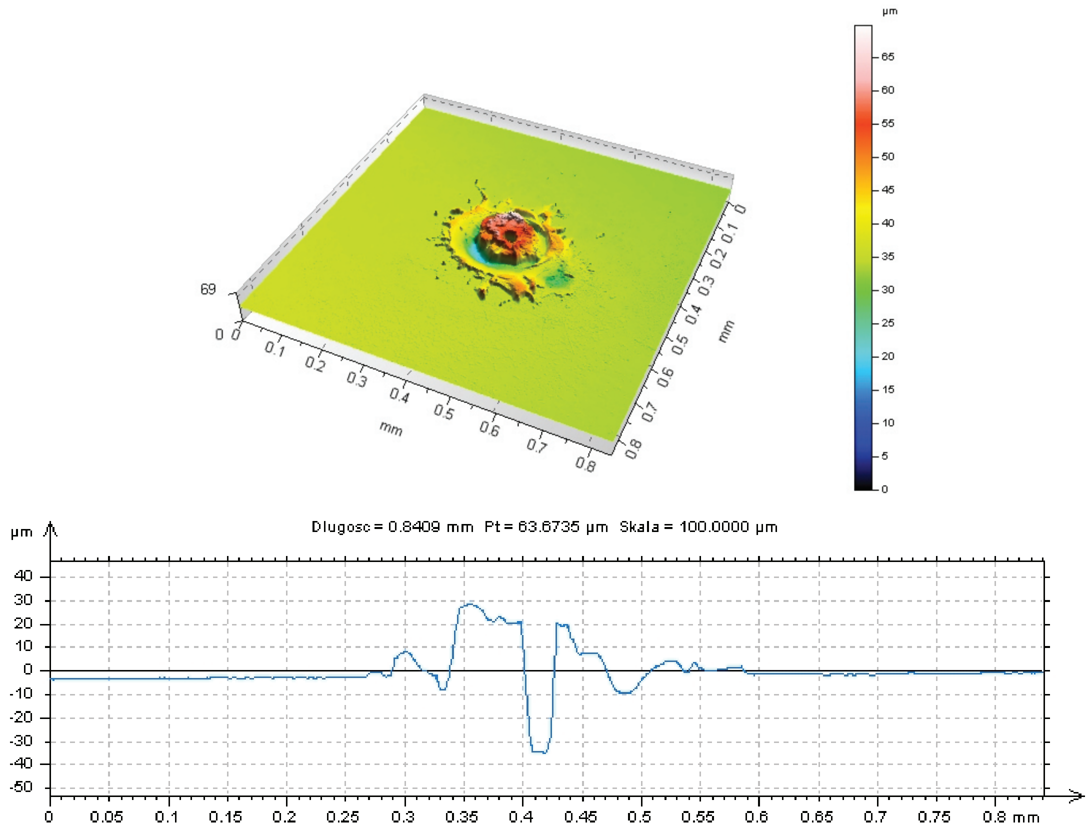

Fig. 1 View of 3D single crater on machined surface made by Talysurf CCI Lite -- Taylor Hobson scanning profilometer type

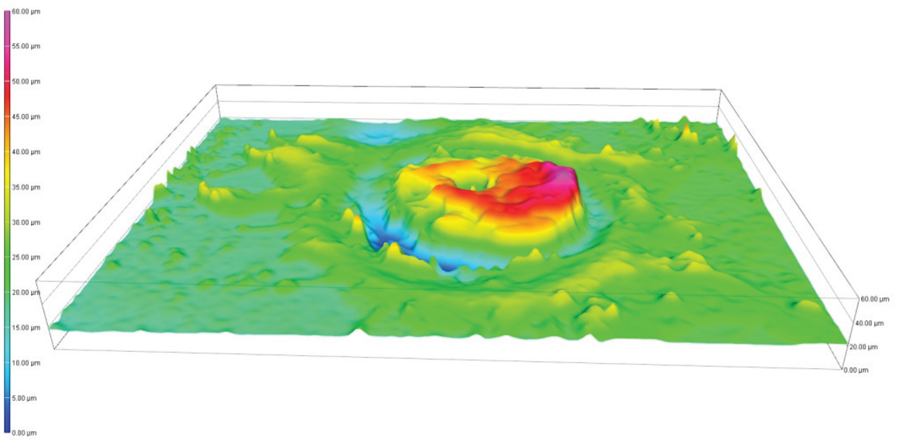

Fig. 2 View of 3D single crater topography on alloying surface made by Nikon Eclipse MA 200

To illustrate structures of ESD of tungsten on a steel were used the optical microscopy. Microscope Nikon Eclipse MA 200 with the image analysis system NIS 4.20 to metallographic specimens testing was used. During the preparation process for the surface layer were cut across and mounted in resin. After proper polishing and etching the weld structure was observed.

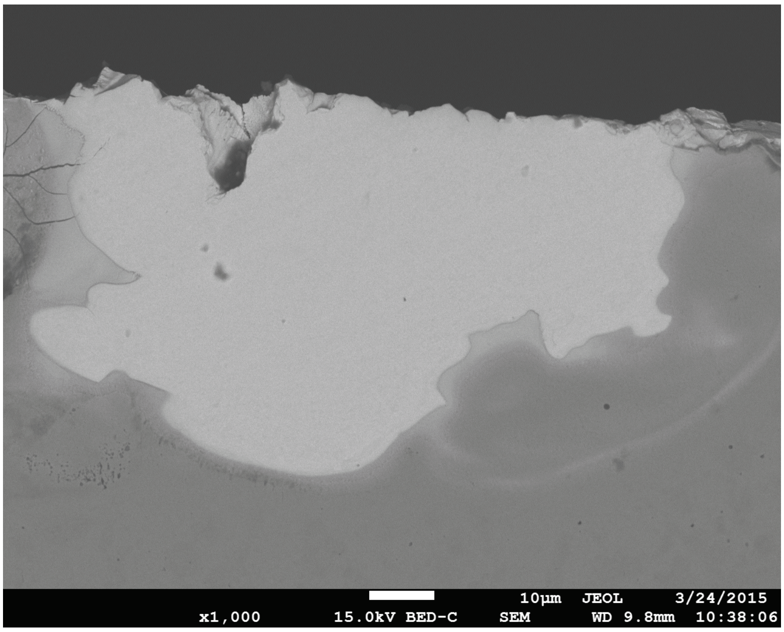

Fig. 3 SEM image of crossection of the single crater on alloyed surface layer after the ESD process (U = 25 *V*) mag. x1000

2.2. Microhardness

Change in micro-hardness is one of basic results of changed chemical composition and surface layer structure after alloying. Microhardness measurements of the surface layer and carbon steel where made. For investigation there was used Matsuzawa Vickers microhardness MX 100 type. There was applied load 100G(0,98 N). Microhardness distribution in a crossection of the surface layer after the ESD process (U = 25 *V*) and material of workpiece carbon steel (C 45). Results are shown in the photograph **Fig. 4**.

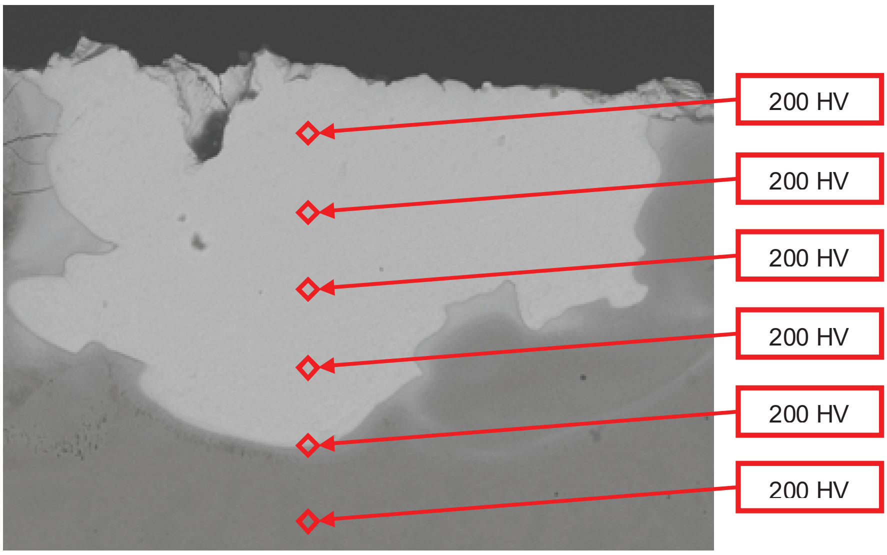

Fig. 4 Microhardness distribution in a crossection of the surface layer after the ESD process (U = 25 V), steel (C 45)

3. SEM EXAMINATION

SEM examination was performed using a JEOL JSM 7100F microscope with field emission (Schottky). X-ray diffraction pattern obtained from the surface layer after the ESD process (U = 25V) using a tungsten electrode shows **Fig. 5**.

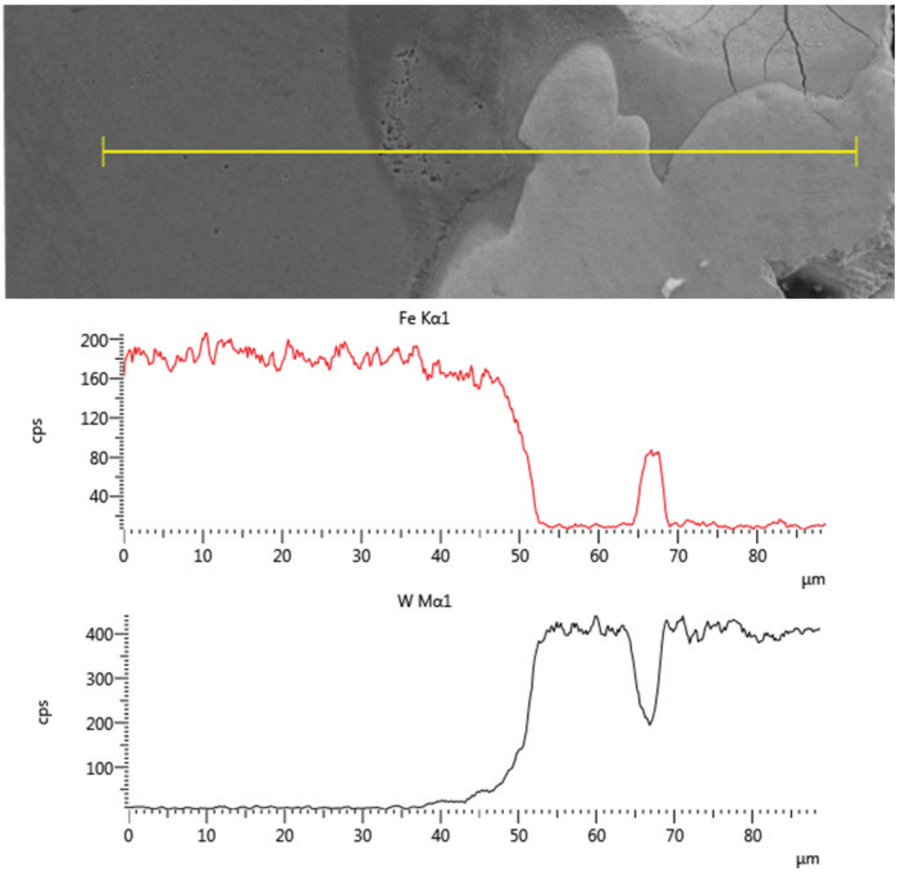

Fig. 5 X-ray line scan of the superficial layer after the ESD process (U = 25 V) using a tungsten electrode - a; chemical elements distribution in the sub-surface layer - b;

4. DISCUSSION OF RESULT

Chemical composition tests for surface layer have been carried out using X-ray micro-analysis. **Fig. 6** shows analysis of chemical composition in points, and we can observed the diffusion of the electrode in to material.

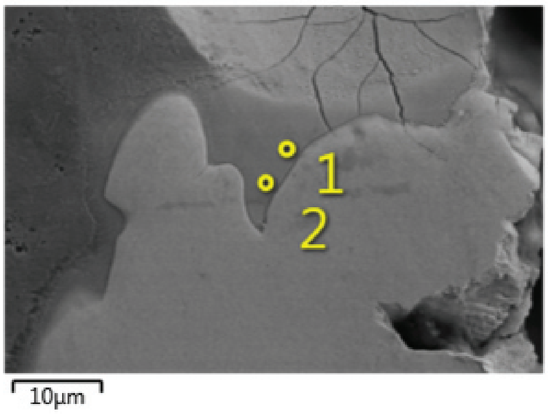

Fig. 6 Analysis of chemical composition in points

Table 1 Composition (in wt %) of the base material (C 45)

Element	1 Wt %	2 Wt %
Fe	31.97	38.40
W	68.03	61.60
Total:	100.00	100.00

5. CONCLUSION

It is possible to apply typical electro-discharge machines for the alloying process.

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