

11-12 October 2012, Riga

**Riga Technical University
53rd International
Scientific Conference**

Dedicated to the 150th Anniversary and
The 1st Congress of World Engineers and
Riga Polytechnical Institute / RTU Alumni

DIGEST

ISBN 978-9934-10-360-5



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Rīga-2012

Table of contents

<u>Computer Science</u>	3
• Boundary Field Problems and Computer Simulation	3
• Technologies of Computer Control	20
• Applied Computer Systems	41
• Information Technology and Management Science	66
<u>Power and Electrical Engineering</u>	98
• Power Engineering	98
• Electrical Machines and Drives, Robotics	107
• Power Electronic Converters and Applications	118
• Process Control	131
• Environmental and Climate Technologies	137
<u>Materials Science and Applied Chemistry</u>	183
• Materials Science	183
• Chemistry and Chemical Technology	217
• Textile and Clothing Technology	278
<u>Humanities and Social Sciences</u>	304
<u>Architecture and Urban Planning</u>	331
<u>Construction Science</u>	359
• Construction Science	359
• Heat, Gas and Water Technology	407
• Geomatics	436
<u>National Economy and Entrepreneurship</u>	451
• Scientific Problems of Technogenic Environment Safety	451
• International Business, Logistics, Customs and Taxes	463
• National and Regional Economics	478
• Production Economics, Finance and Marketing	514
• Quality Technologies and Management	569
<u>Technology Transfer and Innovation</u>	577
<u>Engineering, Mechanics and Mechanical Engineering</u>	581
• Production Engineering	581
• Heat Power and Thermal Physics	597
<u>Transport</u>	606
• Road Transport	606
• Railway Transport	609
• Aeronautics and Transport Systems	619
<u>International Symposium on Biomedical Engineering and Medical Physics</u>	639
<u>Real Estate Economics and Construction Entrepreneurship</u>	740

Composition and Structure of Micro Arc Oxidation Coatings

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Keywords – oxidation of micro arc, anodic oxidation, coatings, vacuum technologies.

I. INTRODUCTION

Micro arc oxidation (MAO) is comparatively new way of surface modification and strengthening of metal materials mainly. Beginning of this method can be seen from traditional anodizing and this is electrochemical process. Using micro arc oxidation allows obtaining polyfunctional ceramic materials (Fig.2.) with unique qualities: wear resistance, corrosion strengths, electric insulation and decorative overlays.

II. EXPERIMENTAL MICRO ARC OXIDATION EQUIPMENT

Experiments were conducted on the equipment constructed in such way that it was possible to make micro arc oxidation on surfaces with different overlay made by ion plasma method with thickness 5 micrometers and more.

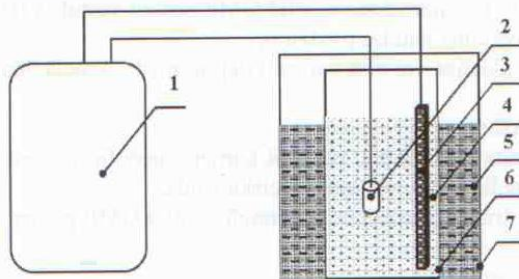


Fig. 1. Arrangements for micro arc oxidation:

1 – power source; 2 – anode; 3 – electrode cathode; 4 – alkaline solution; 5 – cooling solution; 6 – inner reservoir; 7 – outside reservoir

This equipment is constructed in the way that allows to conduct micro arc oxidation process over details with thin overlay. Source of power selected – direct current. Using this type of power allows minimize risks of uncontrolled MAO transition to the phase of electro arc which could damage overlay.

III. COMPOSITION AND STRUCTURE OF MICRO ARC OXIDATION COATINGS

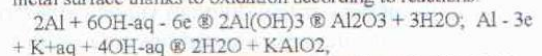
Main phases of MAO:

1. Passivity;
2. Anodizing;
3. Glowing discharge (shining);
4. Sparkling;
5. Intensive micro arc sparking;
6. Arc discharge.

Structure of overlay depends on the nature of material to work with and technological parameters of process:

- Electrolyte;
- Regime;
- Duration of treatment.

Main factors of micro arc oxidation process are composition of electrolytes, support material, regime and duration of treatment. It significantly affects content, structure and qualities of surfaces overlaid. Electrolytes used in micro arc oxidation can be divided in two groups. First group contains electrolytes not containing elements which are able to form indissoluble oxides, for example solution of sulphuric acid or alkali. Overlays made with such electrolytes penetrate into metal surface thanks to oxidation according to reactions:



where KAlO_2 is inside overlay in the shape $\text{b-Al}_2\text{O}_3$ [1].

Structure of overlay during this process can contain several layers, each of it influenced by electrolytes and Technologies used.

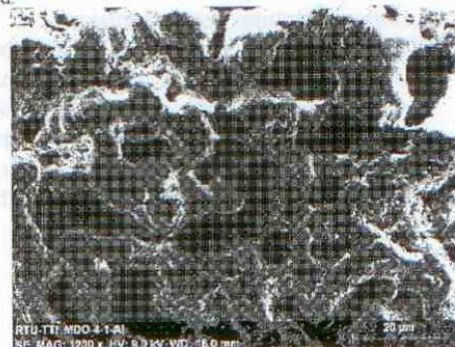


Fig. 2. Microstructure of dielectric overlay on aluminium

Technology of micro arc oxidation is used to process various metals and alloys (Al, Mg, Ti, Ta, Nb, Zr, Be etc.). It is used for metals which oxide membrane is formed in electro chemical way and have monopolar d.c. link in the system metal – oxide – electrolyte.

IV. CONCLUSIONS

Micro arc oxidation is promising process which depends on various circumstances and regularities. Defining interconnections between treated material, parameters and conditions of process will improve exploitation qualities of overlays and will enlarge spheres of application.

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