$Zn\text{-}Al_2O_3$ ELECTRODEPOSITED NANOCOMPOSITES

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INTRODUCTION:

The presence of oxides, carbides, sulfides and graphites dispersed particles in metallic matrix improve the chemical and mechanical properties.Thus, the metallic coatings' application areas are enlarging.

Much expensive than the classical coatings, nanocomposite depositions have perfect characteristics that transcend their prices.

Three important application areas can be distinguished in metalo-ceramic nanocomposite materials case: nanocomposites hardening, wear and corrosion resistance.

In automotive industry, with the purpose of corrosion resistance increasing, it is recomanded the use of $Zn\text{-}Al_2O_3$ and $Zn\text{-}SiO_2$ nanocomposite coatings.

EXPERIMENTAL:

$Zn\text{-}Al_2O_3$ coatings have been obtained through electrodeposition on steel samples. The deposition was realised using an alkaline electrolyte, with a zinc oxide concentration of 10-12 g/l. In the electrolyte was added Merck Al_2O_3 nanoparticle suspension.

Salt spray tests corrosion have been effectuated according to ASTM B117 standard.

The linear polarization measurements of layers in 5% NaCl solution were also performed using a Radiometer PGP 201 potentiostat. The potential range was ±20 mV referring to E_{corr} and the scan rate was kept constant at 0,150 mV/s. All tests were carried out in aerated solutions.

From the obtained values for polarization resistance, R_p, the corrosion currents (i_{corr}) were calculated using Stern-Geary equation:

$$R_p = \frac{B}{i_{corr}} \quad (1); \qquad B = \frac{b_a b_c}{2{,}3(b_a + b_c)} \quad (2);$$

were b_a and b_c are the Tafel slopes.

The values of b_a and b_c were determined separately in an aerated, stagnant, 5% NaCl solution, from potentiodynamic polarization curves.

RESULTS:

The layers' structure was studied by scanning electron-microscopy (SEM).

In Figure 1. and Figure 2. are presented the micrographies of zinc composite electrodeposition with 10 ml/l alumina, 5 A/dm^2 and with 20 ml/l alumina, respectively.

CONCLUSIONS:

1. Non-passivated zinc depositions have 172 hours salt spray resistance, until the basic corrosion appears, in comparison with non-passivated $Zn\text{-}Al_2O_3$ composite depositions, with 72 hours (20 ml/l suspension) and 96 hours (10 ml/l suspension) salt spray resistance, until the the basic corrosion appears.
2. Passivated zinc depositions in hexavalent chromium ions solutions have 172 hours salt spray resistance, until the the basic corrosion appears, in comparison with passivated $Zn\text{-}Al_2O_3$ composite depositions in the same solution, which have 264 hours (20 ml/l suspension) and 288 hours (10 ml/l suspension) salt spray resistance, until the basic corrosion appears.
3. Passivated zinc depositions in trivalent chromium ions solutions have 172 hours salt spray resistance, until the the basic corrosion appears, in comparison with passivated $Zn\text{-}Al_2O_3$ composite depositions in the same solution, which have 144 hours (20 ml/l suspension) and 264 hours (10 ml/l suspension) salt spray resistance, until the basic corrosion appears.

REFERENCES:

1. J. Fransaer, J.P. Celis, J. R. Roos; J. Electrochem. Soc., 139 (1992) 413;
2. P. R. Webb, N. L. Robertson; J. Electrochem. Soc., 141 (1994) 669.

FIGURES:

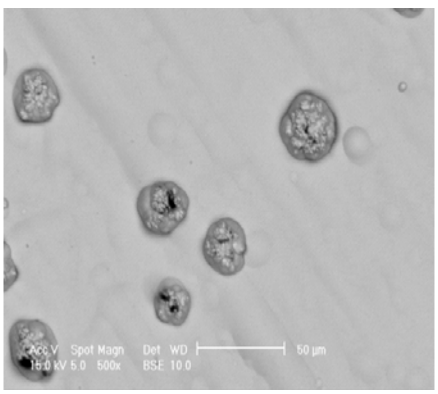

Figura 1. Micrography of Zn composite electrodeposition with 10 ml/l alumina.

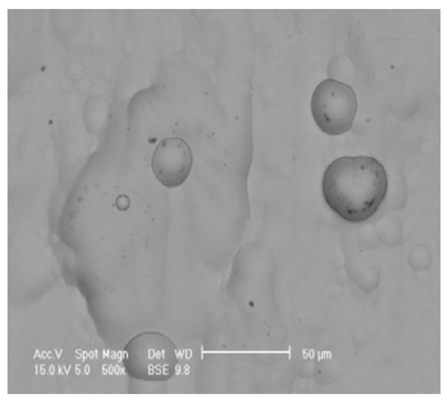

Figura 2. Micrography of Zn composite electrodeposition with 20 ml/l alumina.