Comparative wear corrosion study of nanostructured and microstructured composite coatings obtained by electroplating

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The wear corrosion study was performed to compare the pure nickel and composite coatings obtained by electrodeposition of dispersed particles in a nickel plating bath. The dispersed phases used to obtain composite layers was nano silicon carbide (20 nm), zirconium oxide (6 µm) and silicon carbide (9µm).
A PMMA cell contained the test solution and a transmission shaft with the tested sample, in the shape of a cylinder (diameter 40 mm and height 18 mm), connected to an electrical motor. A moving rod held an alumina parallelepiped counterface and the imposing load system thus obtaining a sliding type wear system. All the experiments concerning the effects of the rotation speed and of the applied load on the corrosion behaviour and friction coefficient were carried out using the 0.5M Na_2SO_4 neutral solution. The E_{corr} values measured at different rotation speed of the disks and different sliding loads show some differences between the two types of coatings (pure metal and composite).

Both measurements of electrochemical corrosion and wear show a better resistance of nancomposite and microcomposite coating compared with pure nickel deposits.
The general corrosion resistance in moving conditions (150 rotation speed) is higher for nanostructured composite coating as it resulted from impedance (Fig. 1) and potentiodynamic diagrams performed. The nanocomposite coating show a bigger polarisation resistance and reduced corrosion current density compared with pure nickel coating before and after sliding the surface.
The friction coefficient of nanocomposite coating (Fig. 2) is smaller compared with pure nickel coating as a result of nanoparticles embedded and the fine nanostructured coating resulted (Fig. 3).

The better behaviour of nano-structured composite coating in wear-corrosion system make it as a suitable candidate in modern techniques to improve the surface properties of materials in special application.

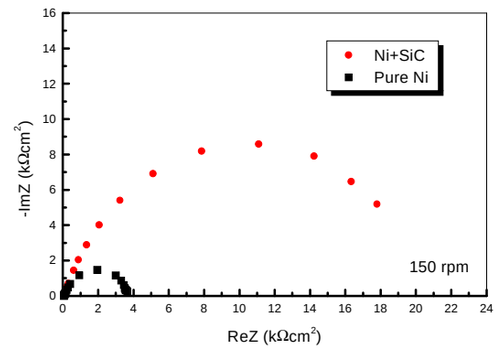

Fig. 1. Impedance diagrams performed in 0.5M Na_2SO_4 at 150 rpm, after 3kg sliding load: (solid circle) nanocomposite coating, E_c =-224 mV (Ag/AgCl) , (solid square) pure Ni coating, E_c= -285 mV (Ag/AgCl

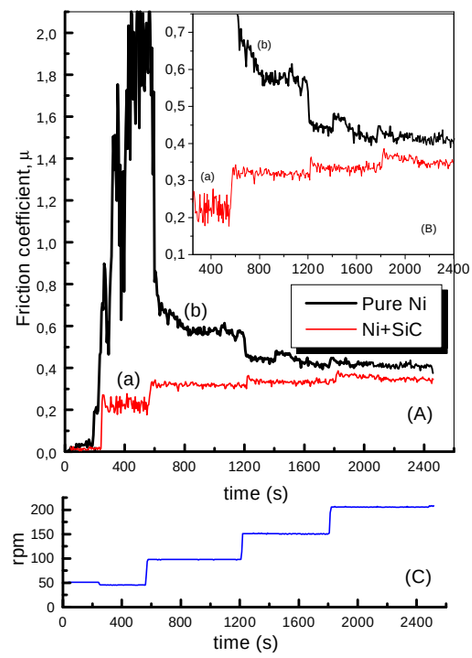

Fig. 2. Friction coefficient of nanocomposite (a) and pure nickel (b) coatings in 0.5M Na_2SO_4 solution, at different rotation speed and constant sliding load (2kg), layer (A). On Layer (B) zoom of final part of layer (A). Layer (C) the rotation speed of samples corresponding to friction coefficient versus time.

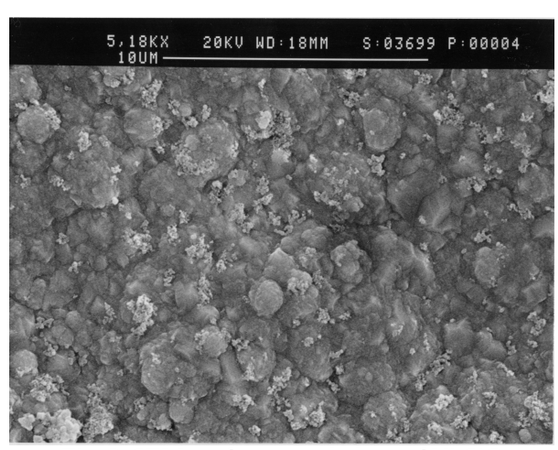

Fig. 3. SEM surface morphology of Ni-SiC nanostructured composite coating