ELECTRODEPOSITED NANO-NI-CO ALLOYS, NANO-NI-CO-NANO-TIO$_2$ AND NANO-NI-CO-μ-AL$_2$O$_3$ COMPOSITES FROM GLUCONATE BATH

By

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Of
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Department of Chemistry
Faculty of science, Fayoum, Egypt

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Electrodeposited Nano-Ni-Co Alloys, Nano-Ni-Co-Nano-Tio_2 And Nano-Ni-Co-µ-Al_2O_3 Composites From Gluconate Bath

الملخص (باللغة الانجليزية)

Environmental issues nowadays have great led to the reduction of pollutants due to their impact on the ecosystem. Electrodeposited nickel-based alloys and composites have increasingly beneficial applications for aerospace, energy generation; wear resistance and corrosion protection. In this work, we have examined the effect of sodium gluconate and cysteine obtained from natural products as additives to produce nano-coated Ni-Co alloys and Ni-Co-TiO_2 and Ni-Co-Al_2O_3 composites.

The effect of conventional ultrasound waves (CUW) and additives on the structure and properties of coated Ni-Co alloys and Ni-Co composites was investigated. Electrochemical behaviour of Ni-Co alloys and Ni-Co composites was performed using potentiodynamic polarization in different aqueous media such as NaOH, NaCl and Na_2SO_4. Microhardness was measured for Ni-Co alloys obtained using CUW. Although it is known that CUW supports using a high current density and produces thick composites, varying between 53µm-151.23µm and can disperse particles, the inclusion of particles can be deterred by CUW. Conversely, if only mechanical stirring is used, particles are incorporated in the nickel and cobalt as coagulated forms. Our results showed that the mixing of mechanical stirring and CUW enhanced the inclusion of particles and produced homogenous dispersion inside the composite.

The coatings were examined using scanning electron microscopy (SEM) and energy dispersive X-Ray (EDAX). Ni alloys improved to dense and smooth deposits as a result of using of conventional ultrasound waves and additives, and Ni-TiO_2 composites became sponge-like because of inclusion of electrically inert TiO_2. Surface morphology of the coatings changed with alterations of the current density. XRD examination indicated the formation of nanocrystalline materials. The XRD peaks additionally show that Ni-Co-Al_2O_3 and Ni-Co-TiO_2 composites containing up to 75% Co exhibit face-centred cubic (FCC). However, Ni-Co-TiO_2 composites, which contain more than 75% Co, exhibit hexagonal close-packed (HCP). The small grain size of the composites with FCC is 13.98 nm, and that of the coatings with HCP is 21.9nm, and the grain size of TiO2 and Al_2O_3 used is 20- 44.29 nm and 3 µm, respectively.

The presence of inert particles in the composites decreases the corrosion current density i_{corr} and corrosion rate, however increasing of Co in the Ni-Co alloys and Ni-Co composites causes an increase of i_{corr} and corrosion rate. The microhardness of sonicated Ni-Co alloys is increased to very high values with increase of Ni content in the alloys, from about 5000 HV to 7500 HV.