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Electrodeposition of Mn-Zn and Mn-Cu alloys from sulfate solution containing complexing additives

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Due to high negative standard potential and availability, galvanic coatings of manganese and its alloys as protective materials can be promising for industrial exploitation. To decrease chemical reactivity of manganese, it is doped with metals having higher standard potentials such as copper, zinc, cobalt, nickel iron and others. We obtained mirror-like coatings based on a nanocrystalline, globular-shaped Mn-Zn alloy with a high Mn content (97-98%) from a sulfate-ethylenediaminetetraacetic acid disodium salt bath in the presence of sodium selenate (NS) as an additive. The conditions included: 5 $g \cdot l^{-1}$ $ZnSO_4 \cdot 7H_2O$, 10 $g \cdot l^{-1}$ EDTA, 58 $g \cdot l^{-1}$ $MnSO_4$, 68 $g \cdot l^{-1}$ $(NH_4)2SO_4$, 0.33 $g \cdot l^{-1}$ NS, pH 3-5.5; t=30; current density 0.1-0.175 mA/cm^2; plating time τ=15min; coating composition: 97.5-98.5% Mn, 2.5-1.5% Zn; and current efficiency 45.2-51.7%. The nanocrystalline electrodeposited Mn-Zn alloy coating, featured broad and poorly defined diffractograms, x-ray diffractograms, which corresponded to a cubic α-Mn crystal structure. The sodium selenate additive, concentrations and nature of components in solution affected the production of a mirror like coating of the Mn-Zn alloy. The high content of manganese in the coating provides a high negative corrosion potential for the steel substrate therefore providing anodic protection of the steel. Silvery, fine crystalline, solid and nonporous coatings of Mn-Cu alloy are obtained only at high cathodic current densities (ik≥37.5 $A \cdot dm^{-2}$) and within pH 6.5-7.5. Current efficiency of silvery Mn-Cu alloy coating from the electrolyte containing both, complex agent citrate and EDTA in equivalent quantities, was 42% (ik=37.5 $A \cdot dm^{-2}$, pH 6.5, t=30). In the alloy, average content of manganese was 93%, copper 7%. X-ray diffraction pattern of the alloy shows the BCT (body centered tetragonal) γ-Mn solid solution phase with copper.

Biography

David G Gogoli has completed his PhD from Georgian Technical University in 2013. He is a Research Scientist at R Agladze Institute of Inorganic Chemistry and Electrochemistry of I Javakhishvili Tbilisi State University. His scientific interest is related to the field of electrodeposition of manganese alloys and fuel cells. He is an author of more than 10 papers in reputed journals and presentations at 6 international scientific conferences.

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Notes:

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