GALVANIC REPLACEMENT ON SURFACE OF NdFeB MAGNETS IN PYROPHOSPHATE-CITRATE ELECTROLYTE FOR COPPER ALLOYS DEPOSITION

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Permanent magnets, especially sintered NdFeB, are widely used in electronic, electromechanical, and other applications due to their strong magnetic properties. However, their porous structure and the reactivity of Nd and Fe make them highly vulnerable to corrosion, particularly in harsh environments like marine or acidic industrial settings. To prevent premature degradation, protective coatings are essential. Metal coatings such as Ni, Ni–P, Ni–Cu, and Zn are commonly electrochemically deposited [1]. Copper-zinc alloy is also promising for corrosion protection of these magnets.

One of the issues is existence of galvanic replacement in the electrolyte. During this process, oxidation of the magnet surface occurs on the anodic sections and copper deposition (or oxygen reduction) on the surface of the cathodic sections. Galvanic replacement occurs when magnet is immersed in the electrolyte before deposition. Adhesion of the coating that will be deposited on the magnet surface depends on the result of the galvanic replacement: the deposited copper layer may be compact or loose [2, 3].

The galvanic replacement in each system is studied using three curves [4]: change of the open circuit potential of the magnet in the electrolyte ("profile"), polarization curve on copper in electrolyte obtained by nonlinear polarization using profile data, polarization curve on magnet in font solution (electrolyte, in which copper ions are replaced by sodium ions), also polarized using profile data. From these three curves, it is possible to calculate the proportion of the surface area occupied by the cathodic sections, in this case copper, as well as the current density of contact exchange at each moment of the process. In the study the galvanic replacement in the surface of the NdFeB magnets in pyrophosphate-citrate solution of copper deposition is analyzed. This electrolyte is the main component of electrolytes for copper alloys coatings and is analyzed because copper participates in the galvanic substitution process as a more noble metal in these alloys.

References:

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