Electrochemical Deposition of Two Ni-M Alloys

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Electrochemically deposited Ni and Ni-based alloy are known to have good anti-corrosion property, is beautiful in out-looking, and exhibit excellent catalytic property for hydrogen evollution. Thus, these alloy have been widely used and studied in anti-corrosion, surface modification, and electrocatalysis for hydrogen electrode. In this study, two Ni-M alloys were deposited on Cu matrix in aqueous solution under constant current , and factors that affect the deposition process are analysed by chrono-potentiometry and cycling voltmetry.

The basic electrochemical-deposition process are composed of the following steps: 1.Mass transport in liquid phase: The transport of reaction particle(such as hydroated metallic ions) to electrode surface. 2.Transformation: The chemical transformation of reaction particles near electrode surface, such as the reduction of hydroation degree and rearrangement of hydroated metallic ions etc. 3. Charge transfer: Electron acception and reduction of reaction particles to adsorbed metallic atoms. 4.Electrocrystallization: The diffusion of the adsobed metallic atoms along electrode surface to proper sites(growth sites) and the entrance of metallic atoms to metal lattice, or the convergency of metallic atoms to crystal nucei and the growth of nuclei to crystal.

The slowest step of the upper steps is the rate determing step of the whole deposition process.

In fact, the electrochemical deposition process has two aspects: The reduction of metallic ions at cathode(to forming metallic atoms) and the crystallization of the newly formed metallic atoms(electro- crystallization). They are both interdepent and interactional. Based on the present study, it can be deduced that: 1. Surface pretreatment: Surface pretreatment can highly improve surface coasity, and surface defect density. The existed defects at Cu electrode surface provide nucleation sites with lower formation free energy, and the equilibrium reduction potential of metallic ions at treated electrode surface can be lowed. Thus deposition process can be accelerated after proper pretreatment. 2.Reagent A: Reagent A added can lowering the equilibrium reduction potential of metallic atoms, thus the relative over-potential of cathodic reduction is improved, and the nucleation of Ni-M deposit has much higher driving force. 3.Polarization current: The higher polarization current is used, the higher overpotential is needed for deposition.Under lower deposition current, the electrocrystallization of Ni-M alloy is a nucleation and growth process, whereas under higher deposition current, it turn out to be a nucleation process. 4. Hydrogen evolution: During the whole Ni-M deposition procedure, hydrogen evolution is observed. Serious hydrogen evolution inhibit adorption of metallic atoms on electrode surface and prevent the formation of new deposit nucei, and it also bring out convect both in electrolyte and along cathode surface and thus accelerate growth of nuclei, in this case the crystal particle size of deposit formed is large, and the deposit is coarse whereas the depositing rate is relatively high.

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