Mr. Rashid Rizwan
(Ph.D. Scholar, DMME, PIEAS)

Abstract

Zn-Ni and Zn-Co alloy coatings with 5-18 at% Ni and 8-25 at% Co have been prepared by DC plating in additive free chloride baths. Effects of bath composition on the alloy composition, texture, grain size, morphology and hardness were investigated. Potentiodynamic anodic stripping, reverse chronopotentiometry were employed in combination with XRD and EDS to correctly determine the electro-dissolution (dezincification) behavior of alloy electrodeposits. Potentiodynamic cyclic stripping was also performed to prepare compact Zn-Co electrodeposits.

Zn-rich alloy deposits are predominantly formed in these baths due to anomalous codeposition. With the help of careful cyclic voltammetry, chronopotentiometry, chronoamperometry, and (potentiodynamic) cyclic voltammetry, it has been determined that it is primarily the electrochemical potential that determines the deposition mode. Between the window of normal codeposition where nickel or cobalt rich phases are deposited and anomalous codeposition where zinc-rich phases are formed, a region exists where the formation of zinc hydroxide hinders the electrodeposition and cathodic current mostly becomes insignificant. A shift from this region in the negative direction or positive direction allows cathode current for anomalous codeposition and normal codeposition, respectively. The transition potential depends on bath composition and temperature.

Hydrothermal oxidation of Zn, Zn-Ni and Zn-Co electrodeposited on conducting substrates resulted in wide variety of nanostructures depending on the oxidation temperature and alloy content. In case of pure zinc, nanorods with diameter ranging from 300-800nm are seen at oxidation temperature of 100oC. The size of nanorods becomes coarser with rise in oxidation temperature. Hydrothermal oxidation of Zn-Ni alloys resulted in doped ZnO nanostructures with quantity of dopant ranging from 2at% to 11at%. Not only nanorods are synthesized by this technique but also novel structures like nanotulips, hollow nanocones, faceted nanotubes and electronically translucent nanosheets arranged to form nanoflowers are obtained. Here size of nanostructures become finer with rise in temperature, hence presence of nickel and temperature are showing synergistic role in determining the final morphology of the product. Hydrothermal oxidation of Zn-Co alloys resulted in hollow and tubular ZnO nanostructures with doping of cobalt around 2at%.