ADVANCES IN MATERIALS ENGINEERING

Volume 2

Edited By:
Md Abdul Maleque
Iskandar Idris Yaacob
Zahurin Halim

IIUM PRESS
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

ADVANCES IN MATERIALS ENGINEERING VOLUME 2

Edited By:
Md Abdul Maleque
Iskandar Idris Yaacob
Zahurin Halim

IIUM Press

Published by:
IIUM Press
International Islamic University Malaysia

First Edition, 2011
©IIUM Press, IIUM

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without any prior written permission of the publisher.

Perpustakaan Negara Malaysia Cataloguing-in-Publication Data

Md Abdul Maleque, Iskandar Idris Yaacob & Zahurin Halim: Advances in Materials Engineering

ISBN: 978-967-418-168-0

Member of Majlis Penerbitan Ilmiah Malaysia -- MAPIM
(Malaysian Scholarly Publishing Council)

PRINTED BY:
IIUM PRINTING SDN.BHD.
NO. 1, JALAN INDUSTRI BATU CAVES 1/3
TAMAN PERINDUSTRIAN BATU CAVES
BATU CAVES CENTRE POINT
68100 BATU CAVES
SELANGOR DARUL EHSAN
TEL: +603-6188 1542 / 44 / 45 FAX: +603-6188 1543
EMAIL: iiumprinting@yahoo.com

Table of Content

Chapter 021

Normal Deposition to Anomalous Deposition

Suryanto
Faculty of Engineering – International Islamic University Malaysia
✉ : surya@iium.edu.my

Keywords: Electrodeposition, Zinc-nickel alloy, Anomalous co-deposition.

Abstract. Zinc-nickel alloys were electrodeposited from a sulphate based electrolyte. The effect of deposition current density on alloy composition was determined for an electrolyte containing 0.58 mol/l nickel sulphate and 0.92 mol/l zinc sulphate. At current densities exceeding 0.01 A/dm^2, a transition from normal deposition to anomalous co-deposition (i.e where the less noble metal deposits preferentially) was observed and alloys rich in zinc were obtained. The transition current density was observed to increase with an increase in electrolyte temperature or a decrease in electrolyte pH. The electrodeposition mechanism for zinc-nickel alloys in the transition region was studied in detail. The results were consistent with the suppression of nickel deposition due to the precipitation of zinc hydroxide on the cathode surface. This was supported by pH measurements made in the vicinity of the cathode where a rise in pH was detected as the transition current density was approached and exceeded the critical pH for zinc hydroxide precipitation.

Introduction

Development of zinc alloys formed with relatively noble metals such as iron, cobalt and nickel has led to the commercial production of less active zinc base coatings with increased corrosion resistance. Electrodeposited zinc-nickel alloys have attracted the interest of the aerospace industry as a high level of corrosion resistance can be obtained with only moderate additions of the more expensive alloying metal being required.

Zinc can be alloyed with the iron-group metals by electrodeposition from aqueous solutions containing sulphates or chlorides. The electroplating of zinc-nickel alloys has been known. However, the mechanisms by which zinc-nickel alloys are deposited are less well understood. In the present work, the electrodeposition mechanisms of zinc-nickel alloys have been studied using acidic baths, employing galvanostatic and potentiodynamic polarisation techniques.

Deposition

Electrolytes were prepared by dissolving zinc and nickel sulphates in distilled water. The desired nickel content range in the alloys for optimum corrosion resistance was most readily obtained with an electrolyte containing approximately 40%wt nickel. This electrolyte was prepared by dissolving 0.92 mol/l Zn and 0.58 mol/l Ni in distilled water and was used for subsequent studies into the effects of electrolyte temperature and pH. Electrolytes were prepared at pH 4.5 and were also acidified to pH 3.5 and below by additions of 0.5 mol/l sulphuric acid.