ORGANIC AND INORGANIC PASSIVATION PERFORMANCE ON ELECTROLESS NICKEL (LP)

SHARQIYAH BINTI ABDUL MALICK

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Faculty of Mechanical Engineering
Universiti Teknologi Malaysia

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To my beloved Abah and Mak..

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ABSTRACT

Passivation is a very important process after Electroless Nickel (EN-P) plating where it serves to protect the nickel surface against further dissolution or corrosion. Passivation will reduce the reactivity of chemically active metal surface by immersion in a passivation solution. The objectives of this study were to investigate and analyse the organic and inorganic passivation on EN low phosphorous (LP) of the characteristics and corrosion performance on the aluminium alloy component. There are two types of passivation solution that had been used which were chromic acid based solution (inorganic type) and silicate based solution (organic type) and it was found that their optimum passivation time were 210 sec and 90 sec respectively. FESEM (EDX) was used to characterize the surface of EN-P layers with both passivation types. XRD was also used to characterize the compound bonding nature of elements on the EN-P surface. FESEM (EDX) and XRD results showed that the EN-P surface with organic and inorganic passivation were oxidized and composed of nickel oxide, nickel hydroxide, and nickel phosphate, but for organic passivation its exhibits the presence of silicon. It was also shown that the passivation layer thickness was in the range of between 200 to 300 nm. Salt spray test was used to study their corrosion performance for 24, 48, and 72 hours. Most of the specimens were corrode as EN (LP) did not performed corrosion protection to the substrate as EN (HP). However, specimens with organic passivation exhibited more corrosion resistance as indicated from the corrosion rate analysis.

ABSTRAK

Passivation adalah suatu proses yang amat penting selepas proses *Electroless Nickel* (EN-P) dimana ia akan melindungi permukaan logam daripada tindakbalas selanjutnya atau kakisan. *Passivation* akan mengurangkan tindakbalas kimia terhadap permukaan logam yang aktif dengan pengutuban elektrokimia atau rendaman di dalam larutan *passivation*. Objektif bagi kajian ini adalah untuk mengkaji sifat-sifat dan perlaksanaan kakisan mengenai *passivation* secara organik atau tidak organik terhadap *electroless nickel* rendah fosforus EN (LP) pada komponen aloi aluminium. Terdapat dua jenis larutan *passivation* yang digunakan iaitu larutan asas asid kromik (jenis tidak organik) dan larutan asas silikat (jenis organik) dan didapati bahawa masa optimum bagi *passivation* adalah 210 saat dan 90 saat bagi masing-masing. FESEM (EDX) telah digunakan untuk menggambarkan sifat bagi permukaan lapisan EN-P dengan kedua-dua jenis *passivation*. XRD juga digunakan untuk mengkaji ikatan semulajadi bagi gabungan elemen-elemen pada permukaan EN-P. Keputusan bagi FESEM (EDX) dan XRD menunjukkan bahawa permukaan EN-P dengan *passivation* secara organik atau tidak organik akan teroksida dan mengandungi nikel oksida, nikel hidroksida, dan nikel fosfat tetapi *passivation* secara organik juga membentuk silikon pada permukaan EN-P. Ia juga menunjukkan bahawa lapisan *passivation* mempunyai ketebalan antara 200 hingga 300 nm. Ujian semburan garam pula digunakan untuk mengkaji perlaksanaan kakisan selama 24, 48, dan 72 jam. Hampir semua spesimen terkakis kerana EN (LP) tidak memberi perlindungan kakisan terhadap logam asas. Walaubagaimanapun, spesimen dengan *passivation* secara organik memberi lebih rintangan terhadap kakisan sebagaimana yang terdapat pada analisis kadar kakisan.

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LIST OF ABBREVIATIONS

ASTM	-	American Society for Testing and Materials
EN	-	Electroless nickel
EN-P	-	Electroless nickel-phosphorous
EN (HP)	-	Electroless nickel high phosphorous
EN (LP)	-	Electroless nickel low phosphorous
EDX	-	Energy dispersive spectrum
FESEM	-	Field emission scanning electron microscope
Ni-P	-	Nickel phosphorous
Ra	-	Surface roughness
XPS	-	X-ray photoelectron spectroscopy
XRD	-	X-ray diffraction

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CHAPTER I

INTRODUCTION

4.1 Title

Organic and Inorganic Passivation Performance on Electroless Nickel (LP).

4.2 Background Study

Over more than two decade, electroless plating or known as EN does have widely commercial applications in many fields as a coating technique that used on a solid part like a metal and its alloy, and also plastic because of its excellent properties.. It is still a growing industry in Malaysia as there was not much manufacturer that using this plating technique. The applications of this plating technique can be found in virtually every industry such as aerospace, automotive, chemical processing industry, food processing industry, electronics, and others. The range of nickel-phosphorous alloy as the coating material can be varied with the percentage of phosphorus that is from low phosphorous to medium phosphorous and high phosphorous. There are several processes applied for this method starting with pre-treatment process, plating, and post-treatment process. Each process will give an effect on the plated component whether it is good or not. Passivation is one of the post-treatment processes which is very important for the final touch to the component. After the substrate was coated by Ni-P layer, the passivation is needed to deactivate the Ni-P layer which is in an active form. Generally, there are two types of passivation layer; organic and inorganic. These types of passivation layer have different composition, characteristics, and performances but still give the same function on the EN plating process.

4.3 Objectives of the Study

To study organic and inorganic passivation of EN (LP) on characteristics and corrosion performance on the aluminium alloy component.

4.4 Scope of the Study

1. Electroless Nickel (HP)
    a. Surface morphology
    b. Thickness
    c. Characterization.

2. Passivation (organic and inorganic base)

    a. Thickness
    b. Salt spray test
    c. Surface morphology
    d. Characterization.