

TABLE OF CONTENTS

TITLE	<i>PAGE</i>
summary	<i>i</i>
List of table	<i>iv</i>
List of figure	<i>v</i>
List of abbreviations	<i>ix</i>
 CHAPTER 1	
1. Introduction	<i>1</i>
1.1. The history of packaging science	<i>1</i>
1.2. Nanotechnology	<i>3</i>
1.2.1. Nanocomposite polymer	<i>4</i>
1.2.2. Nanoparticles, Methods of preparation	<i>5</i>
1. 2.3 Techniques of nanocomposite formulation	<i>6</i>
1.2.3.1 In situ intercalative polymerization	<i>6</i>
1.2.3.2 Melt intercalation	<i>7</i>
1.2.3.3. Template synthesis	<i>7</i>
1.2.3.4. Intercalation of prepolymer from solution	<i>8</i>

1. 3. corrosion	8
1.3.1. Simplified theory of corrosion	8
1.3.2. The chemistry of corrosion reactions	9
1.3.4. Protection of metals against corrosion using coatings	16
1.3.4.1. Barrier effect	16
1.3.4.2. The barrier pigment effect	19
1.3.4.3. Cathodic (Zinc-Rich) protection	23
1.3.4.4. Zinc-Rich primers	25
1.3.4.4.1. Organic Zinc-Rich primers	25
1.3.4.4.2. Inorganic Zinc-Rich primers	27
1.3.4.5. Intermediate and finish coats for steel	28
1.3.4.5.1. Lacqers, Thermoplastic coating	28
1.3.4.5.2. Latex	29
1.3.4.5.3. Oxidizing system	30

1.3.4.5.3. Chemically curing thermosets	30
1. 4. Polyaniline	32
1.5. Zinc phosphate	35
1.6.Literature Review	36
1.7. Research Scope	47
1.8. Research Objective	47
 CHAPTER 2	
Synthesis & Characterization Techniques	
2.1. Chemicals	48
2.2. Instrumentation	48
2.2.1 Vibrational Spectra (FTIR)	48
2.2.2 Determination of molecular weight by gel permeation chromatography (GPC)	48
2.2.3 Thermogravimetry Analysis (TGA)	49
2.2.4 X-Ray Diffraction (XRD)	49
2.2.5 Transmission Electron Microscope (TEM)	49
2.2.6 Energy Dispersive X-ray photoelectron spectroscopy (EDX)	50
2.2.7 Scanning Electron Microscope(SEM)	50
2.2.8 Electrochemical technique	50
2.2.9 Dielectric	53
2.3. Synthesis	54

2.3.1 Preparation of nano $\text{Zn}_3(\text{PO}_4)_2 \cdot 4\text{H}_2\text{O}$	54
2.3.2 Preparation of PANI- $\text{Zn}_3(\text{PO}_4)_2 \cdot 4\text{H}_2\text{O}$ Nanocomposite	54
2.3.3 Preparation of epoxy primer modified with PANI- Zinc phosphate	56
2.4. Preparation of steel panels for testing purposes	56
2.5. Methods of testing of painted film	57
2.5.1. Fineness	57
2.5.1.1. Test Method	57
2.5.1.1.1 Tapered Gage	57
2.5.1.1.2 Stepped Gage	57
2.5.2 Drying time	60
2.5.3 Gloss	60
2.5.4 Adhesion	61
2.5.5 Impact	62
2.6. Testing of corrosion resistance properties	62
2.6.1. Gravimetric techniques	62
2.6.2. Physical tests	63
2.6.2.1. Determination the degree of blistering of paints	63
2.6.2.1.1 Size	64

2.6.2.1.2 Frequency	64
2.6.2.2. Determination the degree of rusting on painted steel surface	67
2.6.2.3 Determination of painted or coated specimens subjected to corrosive environments (scribe failure)	68
2.6.3 Electrochemical methods	69
2.6.3.1 Potentiostatic polarization technique (Tafel polarization)	69
2.6.3.2 Potentiodynamic anodic polarization technique (Pitting potential)	69
2.7. measuring the electrical properties	70
CHAPTER 3	
Result and Discussion	
3.1. Synthesis of PANI and PANI- Zn ₃ (PO ₄) ₂ ·4H ₂ O nanocomposite.	71
3.2. Elements analysis	71
3.3. Vibrational Spectroscopic Characterization of PANI and its Composite	72
3.4. Determination of molecular weight by gel permeation chromatography (GPC)	74
3.5. Thermogravimetry Analysis (TGA)	75
3.6. X-Ray Diffraction (XRD)	77

3.7. Morphology and size of nano Zinc Phosphate tetrahydrate and PANI- $\text{Zn}_3 (\text{PO}_4)_2 \cdot 4\text{H}_2\text{O}$ Nano composites	81
3.8. Testing of painted film measurements	83
3.9. corrosion resistance Measurements	84
3.9.1 Gravimetric Measurements	84
3.9.2 Physical measurements	92
3.9.2.1 The surface morphology of the steels after corrosion	95
3.9.3 Electrochemical Measurements	97
3.9.3.1 Potentiostatic Measurements	97
3.9.3.2 Potentiodynamic Anodic polarization Measurements	102
CHAPTER 4	
Conclusion & Recommendation	
4.1 Conclusion	105
4.2 Recommendation	106
4.3 Reference	107
4.4 Appendix	116
4.5 الملخص العربي	118

