

**THE INFLUENCE OF ELECTROLYTE ON THE ELECTROCHEMICAL
PROPERTIES OF REDUCED GRAPHENE OXIDE/NICKEL – BASED
TERNARY NANOCOMPOSITE**

DANIEL FAZLAN BIN ATAN

**Final Year Project Report Submitted in
Partial Fulfilment of the Requirements for the
Degree of Bachelor of Science (Hons.) Physics
in the Faculty of Applied Sciences
Universiti Teknologi MARA**

JANUARY 2020

TABLE OF CONTENTS

	Page
ACKNOWLEDGEMENTS	iii
TABLE OF CONTENTS	iv
LIST OF TABLES	vi
LIST OF FIGURES	vii
LIST OF ABBREVIATIONS	viii
ABSTRACT	ix
ABSTRAK	x
CHAPTER 1 INTRODUCTION	1
1.1 Background of study	1
1.2 Problem statement	3
1.3 Significant of study	4
1.4 Objectives of study	5
CHAPTER 2 LITERATURE REVIEW	6
2.1 Introduction	6
2.2 Supercapacitor	6
2.3 Supercapacitor performance evaluation	9
2.3.1 Capacitance	9
2.3.2 Energy density and power density	10
2.3.3 Equivalent series resistance	11
2.4 Electrolyte	12
2.4.1 Acid electrolyte	13
2.4.2 Alkaline electrolyte	16
2.4.3 Neutral electrolyte	16
CHAPTER 3 METHODOLOGY	17
3.1 Introduction	17
3.2 Materials	18
3.3 Electrochemical characterization	18
3.3.1 Cyclic voltammetry	19
3.3.2 Working electrode	22
3.3.3 Reference electrode	23
3.3.4 Counter electrode	23
3.4 Materials and Reagent	24

3.4.1	Preparation of sulphuric acid	24
3.4.2	Preparation of potassium hydroxide	25
3.4.3	Preparation of sodium hydroxide	25
3.4.4	Preparation of 10 %, 20 % and 30 % of rGO/Ni	25
CHAPTER 4 RESULTS AND DISCUSSION		26
4.1	Specific capacitance	26
4.2	The effect of electrolyte on the specific capacitance of rGO/Ni	27
4.2.1	10 % of Nickel loading	27
4.2.2	20 % of Nickel loading	31
4.2.3	30 % of Nickel loading	34
CHAPTER 5 CONCLUSION AND RECOMMENDATIONS		38
5.1	Summary	38
5.2	Future research	39
CITED REFERENCES		41
CURRICULUM VITAE		43

LIST OF FIGURES

Figure	Caption	Page
Figure 2.1	Schematic diagram of EDLC (Vangari <i>et al.</i> , 2013)	7
Figure 2.2	Schematic diagram of pseudocapacitor (Vangari <i>et al.</i> , 2013)	8
Figure 2.3	Schematic diagram of hybrid supercapacitor (Vangari <i>et al.</i> , 2013)	9
Figure 3.1	Summary of overall methodology	17
Figure 3.2	Input and output responses of cyclic voltammetry (Choudhary <i>et al.</i> , 2017)	20
Figure 3.3	Schematic representation of electrochemical cell experiment using CV (Elgrishi <i>et al.</i> , 2018)	22
Figure 4.1	CV curve of rGO/Ni 10 in a) H ₂ SO ₄ , b) KOH and c) NaOH	29
Figure 4.2	The C _s trends at various scan rates for rGO/Ni 10	30
Figure 4.3	CV Curve of rGO/Ni 20 in a) H ₂ SO ₄ , b) KOH and c) NaOH	33
Figure 4.4	The C _s trends at various scan rates for rGO/Ni 20	34
Figure 4.5	CV Curve of rGO/Ni 30 in a) H ₂ SO ₄ , b) KOH and c) NaOH	36
Figure 4.6	The C _s trends at various scan rates for rGO/Ni 30	37

ABSTRACT

THE EFFECT OF ELECTROLYTE ON THE ELECTROCHEMICAL PROPERTIES OF REDUCED GRAPHENE OXIDE/NICKEL – BASED TERNARY NANOCOMPOSITE

In this work, the effect of electrolyte on the electrochemical performance of reduced Graphene oxide/Nickel (rGO/Ni) was studied. Its electrochemical performance in three different electrolytes, H₂SO₄, KOH and NaOH was investigated. The dopant concentration used in this study are 10 %, 20 % and 30 % of Nickel loading. The composite exhibits different capacitive behaviour in different aqueous electrolytes, demonstrating the highest specific capacitance (1751.93 Fg⁻¹) at 30 % of Nickel loading in the H₂SO₄ electrolyte due to it having highest molar ionic conductivity compared to the other electrolytes used. The scan rate somehow affected the specific capacitance values, where at lower scan rate shows higher value of specific capacitance due to the faradaic reaction occur between the electrolyte and electrode is longer at higher scan rate.