



Cairo University

# NOVEL SYNTHESIS OF NANOLUBRICANT BY ARC DISCHARGE PROCESS

By

Hesham Mohamed Mohamed El-Sherif Hassan

A Thesis Submitted to the  
Faculty of Engineering at Cairo University  
in Partial Fulfillment of the  
Requirements for the Degree of  
MASTER OF SCIENCE  
in  
Mechanical Design and Production Engineering

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**Title of Thesis:**

Novel Synthesis of Nanolubricant by Arc Discharge Process

**Key Words:**

Arc Discharge, Carbon Nanotubes, Carbon Blacks, Paraffin Oil, Nanolubricant.

**Summary:**

Recently, nanoparticles are used as additives to improve the tribological behavior of lubricating oil. This study is basically concerned with studying the tribological behavior of lubricated contents when introducing nano scale additive of carbon particles to lubricating oils.

A test apparatus was developed to synthesis carbon nanomaterials by arc discharge between two pure graphite electrodes in liquid medium of deionized water or paraffin oil. Also a microcontroller circuit was devised and attached to apparatus in order to maintain the arc with continuous and safe operation.

Carbon Nanotubes (CNTs) was produced by arc discharge process from the anode material by using deionized water as discharge medium. It was found that the efficiency of the arc process range between ~15% and ~35%. The CNTs were added to commercial oil from the local market. It was found that addition of 0.01% of CNTs into Mobil Oil (20W50) reduces the coefficient of friction by ~35%, and improves the wear scratch length and width with average ~18% and ~20% respectively at loads below normal load of 84 N.

Carbon Black (CB) was synthesized by arc discharge in Medical-Grade Paraffin Oil (MGPO) medium with 23.7 C.st. kinematic viscosity. The source of the Carbon Blacks was the paraffin oil medium itself. The yield rate was ~58 times greater than the total-yield rate in case of applying arc in deionized water medium. The as-prepared MGPO from the arc discharge was tested and results indicated to reduction in its kinematic viscosity at 40°C by ~22%, increase in flash point by ~3%, reduction in coefficient of friction by ~29%, significant improvement in the wear scratch, and no effect on fire and pour points.

A set of experiments were conducted on an Industrial-Grade Paraffin Oil (IGPO) medium with 110 C.st. kinematic viscosity. Results from applying the arc discharge for 5 minutes indicates to decrease on the average oil kinematic viscosity at 40°C by ~13.6%, decrease on the average coefficient of friction by ~7.4%, and no effect on the flash and pour points.

It may be contributed that nanolubricant can be produced directly by arc discharge process in liquid paraffin oil medium. The arc discharge in paraffin oil can be applied industrially as a new stage of arc discharge for introducing CB nanoparticles into the oil before the next stages of addition of other additives.





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# **Dedication**

*Dedicated to my beloved family ...*



# Table of Contents

<b>ACKNOWLEDGMENTS .....</b>	<b>I</b>
<b>DEDICATION.....</b>	<b>III</b>
<b>TABLE OF CONTENTS.....</b>	<b>V</b>
<b>LIST OF FIGURES .....</b>	<b>IX</b>
<b>LIST OF TABLES .....</b>	<b>XIV</b>
<b>LIST OF ABBREVIATIONS.....</b>	<b>XV</b>
<b>ABSTRACT .....</b>	<b>XVII</b>
<b>CHAPTER 1 : INTRODUCTION .....</b>	<b>1</b>
1.1. NANOTECHNOLOGY .....	1
1.2. TRIBOLOGY .....	1
1.3. LUBRICATION .....	1
1.4. NANOTRIBOLOGY .....	2
1.5. NANOLUBRICANTS .....	2
1.6. MOTIVATIONS BEHIND THESIS .....	3
1.7. THESIS OUTLINE .....	3
<b>CHAPTER 2 : LITERATURE REVIEW .....</b>	<b>5</b>
2.1. CRUDE OIL.....	5
2.2. PARAFFIN OIL.....	6
2.3. CARBON ALLOTROPES.....	6
2.4. CARBON NANOTUBES (CNTS) .....	7
2.4.1. Types of Carbon Nanotubes .....	8
2.4.2. Morphology of Carbon Nanotubes by Transmission Electron Microscope .....	8
2.4.3. Synthesis of Carbon Nanotubes .....	9
2.4.3.1. Synthesis of Carbon Nanotubes by Arc discharge Method .....	9
2.4.3.2. Growth Mechanisms of Carbon Nanotubes by Arc Discharge Method .....	11
2.4.3.2.1. Harris Model .....	11
2.4.3.2.2. Buchholz Model .....	12
2.5. CARBON BLACK (CB).....	13
2.5.1. Morphology of Carbon Black by Transmission Electron Microscope .....	14
2.5.2. Production of Carbon Black by Oil Furnace Process .....	15
2.5.3. Applications of Carbon Black.....	16
2.5.3.1. Rubber Products: .....	16

2.5.3.2. Plastics: .....	16
2.5.3.3. Electronic Devices: .....	16
2.5.3.4. High Performance Coatings: .....	16
2.5.3.5. Printing Inks: .....	16
2.5.4. Difference between Soot and Carbon Black .....	16
2.6. ARC DISCHARGE PLASMA.....	17
2.6.1. Types of Arc Discharge Plasma.....	18
2.6.2. Synthesis of Nano-Sized powder by Arc Discharge Plasma .....	19
2.6.3. Control System of Arc Discharge Process .....	20
2.6.3.1. Maintaining a Continues Arc Discharge .....	20
2.6.3.2. Maintaining a Fixed Solution Temperature .....	20
2.6.4. Parameters Affecting the Arc Discharge Process .....	21
2.6.5. Review of Nanoparticles Produced by Arc Discharge in Liquid Mediums ...	23
2.6.5.1. Non-Hydrocarbon Liquid Medium.....	23
2.6.5.2. Hydrocarbon Liquid Medium .....	23
2.7. NANOPARTICLES IN LUBRICATING OILS .....	28
2.7.1. Classification of Nanoparticles in Lubricating Oils.....	29
2.7.2. Review of Carbon Base Nanomaterials in Lubricating Oils.....	29
2.7.2.1. Carbon Nanotubes in Lubricating Oils .....	29
2.7.2.2. Graphite Nanoparticles in Lubricating Oils.....	32
2.8. WHY NANOPARTICLES IMPROVE TRIBOLOGICAL BEHAVIOR OF THE LUBRICATING OIL.....	33
2.9. SUMMARY OF LITERATURE .....	34
2.10. OBJECTIVE.....	34
<b>CHAPTER 3 : EXPERIMENTAL WORK .....</b>	<b>35</b>
3.1. TEST APPARATUS .....	37
3.1.1. Mechanical Structure .....	37
3.1.2. Power Source .....	37
3.1.3. Monitoring Units.....	37
3.1.3.1. Monitoring Meters .....	38
3.1.3.2. Monitoring Sensors.....	38
3.1.4. Control Unit .....	40
3.2. MATERIALS .....	41
3.2.1. Electrodes.....	41
3.2.2. Discharge Medium.....	41
3.2.2.1. Deionized Water .....	41
3.2.2.2. Paraffin Oil .....	41
3.3. ARC DISCHARGE IN DEIONIZED WATER.....	42

3.3.1. Preparation of Carbon Nanotubes .....	42
3.3.2. Calculations of the Resultant Total-Yield .....	43
3.3.3. Purification.....	44
3.3.4. Adding Carbon Nanotubes to Commercial Oil (Mobil 20W50) .....	45
3.4. ARC DISCHARGE IN PARAFFIN OIL.....	46
3.4.1. Arc Discharge in Medical-Grade Paraffin Oil (MGPO).....	46
3.4.2. Arc Discharge in Industrial-Grade Paraffin Oil (IGPO).....	47
3.4.3. Measurement of Yield Rate of Resultant Nanoparticles.....	48
3.5. CHARACTERIZATION OF NANOMATERIALS BY TRANSMISSION ELECTRON MICROSCOPE.....	49
3.6. ASSESSMENT OF OIL PHYSICAL PROPERTIES .....	50
3.6.1. Viscosity .....	50
3.6.2. Flash/ Fire/ Pour Point .....	50
3.6.3. Dispersion Study of Nanoparticles in Paraffin Oil .....	51
3.6.4. Oil Elemental Analysis .....	52
3.7. ASSESSMENT OF OIL TRIBOLOGICAL BEHAVIOR .....	53
3.7.1. Cross Cylinders.....	53
3.7.2. Four-Ball Machine .....	55
3.7.3. Ball-on-Disk Machine.....	56
<b>CHAPTER 4 : RESULTS AND DISCUSSIONS .....</b>	<b>57</b>
4.1. ARC DISCHARGE IN DEIONIZED WATER.....	57
4.1.1. Transmission Electron Microscope (TEM) of Carbon Nanotubes .....	57
4.1.1.1. Sample from Floating Material.....	57
4.1.1.2. Sample from Precipitated Material.....	57
4.1.1.3. Growth Mechanism of CNT from Arc Discharge in Deionized Water.....	60
4.1.2. Yield Rate of CNT from Arc Discharge in Deionized Water.....	61
4.1.2.1. Study of Current Effect on Yield Rate of the Output Materials.....	61
4.1.2.2. Study of Water Temperature Effect on the Arc Efficiency .....	63
4.1.3. Tribological Study of Carbon Nanotubes Additive in Commercial Oil .....	65
4.1.3.1. Coefficient of Friction Study .....	65
4.1.3.2. Wear Scratch Study .....	67
4.2. ARC DISCHARGE IN MEDICAL-GRADE PARAFFIN OIL (MGPO) .....	69
4.2.1. Morphology Analysis by Transmission Electron Microscope .....	69
4.2.1.1. Carbon Black Morphology .....	69
4.2.1.2. Other Carbon Structures .....	69
4.2.2. Yield Rate of Resultant Nanoparticles.....	72
4.2.3. Dispersion Study.....	73
4.2.4. Elemental Analysis Study .....	73
4.2.5. Physical Properties Study .....	75