

APPROVAL


**DETERMINATION OF THE VARIATION OF NITROGEN PRESSURE
ON THE SURFACE HARDNESS OBTAINED BY NITRIDING STEEL
IN PLASMA FOCUS DEVICE**

by

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DECLARATION

I, the undersigned, hereby declare that this report is my own independent work except as specified in the references and acknowledgements. I have not committed plagiarism in the accomplishment of this work, nor have I falsified and/or invented the data in my work. I am aware of the University regulations on Plagiarism. I accept the academic penalties that may be imposed for any violation.

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ABSTRACT

A 3kJ Mather-type plasma focus device used to carry out plasma nitriding on the surface of AISI 1020 carbon steel. The nitriding process was carried out under different nitrogen gas pressure (0.5, 1.0, 1.5 and 2.0 Torr) and different axial distance of steel from anode tip (40, 60, 80, 100, 120mm). The surface hardness and surface morphology of the nitrided steel were studied through the observation by using Vickers hardness tester and optical microscopy respectively. Lee Model Code was used to measure the dynamic of ion beam emitted by plasma focus device to identify the parameters of ion beam, in term of ion beam energy, ion current and number of ion per shot. The results of ion beam parameters were correlated with the surface hardness of nitrided steel to study their relationships. Efficient nitriding occurred at the operation with 1.0 Torr of nitrogen gas which the steel was placed 40mm above anode tip. A thin non-homogenous layer of shiny white colour iron nitride with 10~30mm diameter was formed on the surface of nitrided steel which indicated the sputtering of steel cause by fast ion beam. The highest average surface hardness at epicenter was found to be 389.5 HV 0.2 with 125.5% of increment than its original value for the steel that treated with 1.0 Torr of nitrogen gas which the steel was placed 40mm above anode tip. Due to the fluctuation of the value of surface hardness, the average for highest surface hardness was calculated and found to be 404.8 HV 0.2 with 134.4% of increment for the same sample. The correlation by using Lee Model Code showed that ion beam energy and ion current had their peak value with 16.51J and 27.5kA respectively at the sample with highest surface hardness. The highest number of ions per shot occurred at the nitriding with 1.5 Torr nitrogen gas at 40mm axially above the anode tip.

Keywords: Mather-type plasma focus device, Plasma nitriding, Vickers hardness test, Iron nitride thin film, Lee Model Code

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DEDICATION

This thesis is dedicated to those who have the passion to carry out research in plasma focus and my family who always supported to complete my dream.

TABLE OF CONTENTS

DECLARATION	i
ABSTRACT.....	ii
ACKNOWLEDGEMENTS	iii
DEDICATION.....	iv
TABLE OF CONTENTS.....	v
LIST OF FIGURES	ix
LIST OF TABLES	xiii
LIST OF ABBREVIATIONS.....	xiv
NOMENCLATURE	xv
CHAPTER 1 INTRODUCTION.....	1
1.1. Background.....	1
1.1.1. Plasma.....	2
1.1.2. Plasma Focus	2
1.1.3. Plasma Focus Device	3
1.2. Problem Statement.....	4
1.3. Objectives of the Research.....	5
1.4. Scope of the Research.....	5
1.5. Report Organization.....	7
CHAPTER 2 LITERATURE REVIEW	8
2.1. AISI 1020 Carbon Steel	8
2.1.1. Chemical Composition of AISI 1020 Carbon Steel.....	8
2.1.2. Characteristic of AISI 1020 Carbon Steel	8
2.1.3. Annealing of AISI 1020 Carbon Steel	9
2.2. Nitriding Technology.....	11
2.2.1. Gas Nitriding.....	12
2.2.2. Salt Bath Nitriding.....	13
2.2.3. Glow Nitriding.....	14

2.3. Types of Plasma Focus Device.....	16
2.3.1. Flat Type Plasma Focus Device.....	16
2.3.2. Extended Type Plasma Focus Device.....	17
2.3.3. Spherical Type Plasma Focus Device.....	18
2.4. Operation of Mather-Type Plasma Focus Device.....	20
2.4.1. Working Principle.....	20
2.4.2. Development of Plasma Focus.....	22
2.4.3. Dynamic of Plasma Stream.....	26
2.5. Nitriding with Plasma Focus Device.....	28
2.6. Surface of Substrate after Plasma Nitriding.....	30
2.7. Factors Affecting Surface Hardness of Treated Metal.....	33
2.7.1. Gas Pressure.....	33
2.7.2. Number of Shots of Plasma Focus.....	35
2.7.3. Axial Distance of Substrate from Anode.....	35
2.8. Vickers Hardness Measurement.....	38
2.8.1. Working Principle of Vickers Hardness Tester.....	38
2.8.2. Calculation of Vickers Hardness.....	40
2.8.3. Test Piece.....	41
2.8.4. Advantages and Disadvantages of Vickers Hardness Test.....	41
2.9. Lee Model Code.....	43
2.9.1. The 5 Phase of Lee Model.....	43
2.9.2. Numerical Fitting of Lee Model Code.....	46
2.10. Chapter Summary.....	48
CHAPTER 3 METHODOLOGY.....	49
3.1. Introduction.....	49
3.2. Preparation of Steel Pieces.....	50
3.2.1. Cutting.....	52

3.2.2. Milling.....	52
3.2.3. Annealing.....	53
3.2.4. Polishing and Grinding	56
3.2.5. Vickers Hardness Measurement	58
3.3. Nitriding with Dense Plasma Focus.....	60
3.3.1. Experiment Setup.....	60
3.3.2. Procedures of Firing.....	63
3.4. Procedure of Result Analysis.....	67
3.4.1. Surface Hardness Analysis	67
3.4.2. Surface Analysis	68
3.4.3. Numerical Analysis of Ion Beam.....	69
CHAPTER 4 RESULTS AND DISCUSSION	73
4.1. Surface Hardness Analysis	73
4.1.1. Comparison of Surface Hardness at Different Position.....	73
4.1.2. Comparison of Surface Hardness at Epicenter of Plasma Shot.....	76
4.1.3. Comparison of Highest Surface Hardness at Center Region	80
4.2. Surface Analysis	84
4.2.1. Surface Appearance of AISI 1020 Carbon Steel	84
4.2.2. Surface Morphology of AISI 1020 Carbon Steel	88
4.2.3. Properties of Nitride Layer	91
4.3. Numerical Analysis of Ion Beam.....	93
4.3.1. Pinch Formation for Various Nitrogen Pressure.....	94
4.3.2. Ion Beam Energy for Various Nitrogen Pressure	95
4.3.3. Ion Current for Various Nitrogen Pressure.....	97
4.3.4. Number of Ions per Shot for Various Nitrogen Pressure.....	98
4.4. Chapter Summary	99
CHAPTER 5 CONCLUSIONS AND FUTURE WORK.....	100

5.1. Conclusions.....	100
5.2. Recommendations.....	102
5.3. Future work.....	103
REFERENCES.....	104
Appendix A Firing Sequence of Dense Plasma Focus.....	108
Appendix B Procedure of Vickers Hardness Test.....	111
Appendix C MATLAB Code for Colour Contour	112
Appendix D Surface Hardness of AISI 1020 Carbon Steel.....	115
Appendix E Model Parameters of Ion Beam	155
Appendix F Parameters of Ion Beam Properties.....	175

LIST OF FIGURES

Figure 1.1: Three Types of Chamber Geometries for Plasma Focus Device	3
Figure 2.1: The Fe-Fe ₃ C Phase Diagram	9
Figure 2.2: Schematic for the Absorbtion og N ₂ by Steel.....	12
Figure 2.3: Mechanisms of Salt Bath Nitriding	13
Figure 2.4: Schematic of Glow Nitriding	14
Figure 2.5: Mechanisms and Chamber Appearance during Operation of Glow Nitriding.....	15
Figure 2.6: Filippov Type Plasma Focus Device.....	16
Figure 2.7: Schematic Diagram of Filippov Type Plasma Focus Device.....	17
Figure 2.8: Mather Type Plasma Focus Device.....	17
Figure 2.9: Schematic Diagram of Mather Type Plasma Focus Device.....	18
Figure 2.10: Spherical Plasma Focus Device	19
Figure 2.11: Schematic Diagram of Spherical Plasma Focus Device	19
Figure 2.12: Voltage and Current Curve of Nitrogen Discharge during Plasma Focus Formation.....	21
Figure 2.13: Plasma Dynamics in Plasma Focus Device.....	22
Figure 2.14: Schematic Diagram of Axial Phase.....	23
Figure 2.15: Schematic Diagram of Radial Phase	24
Figure 2.16: Sequence of Compression of Deuterium at 0.4mbar.....	25
Figure 2.17: Graph of Ion Energy versus Ion Emission Time for Dense Plasma Focus	25
Figure 2.18: Schematic of Emission of Fast Ion Beam and Shock Wave	26
Figure 2.19: Illustration of Particle Acceleration Mechanisms inside Plasma Focus Device	27
Figure 2.20: Schematic of Ion Implantation and Ion Beam Mixing	29
Figure 2.21: Periodic Table.....	30
Figure 2.22: EDX Result of Steel Nitrided using Copper Anode.....	31
Figure 2.23: Microstructure of (a) Untreated High Carbon Steel; (b) Nitrited High Carbon Steel under Optical Microscopy.....	31
Figure 2.24: Microstructure of (a) Untreated AISI 304 Stainless Steel; (b) Nitrited AISI 304 Stainless Steel under SEM	32

Figure 2.25: Variation of Microhardness of Zirconium Metal at Different Pressure ..	33
Figure 2.26: Scaling of Ion Beam Intensity as a Function of Filling Gas Pressure	34
Figure 2.27: Variation of Plastic Hardness of Stainless Steel-304 at Different Axial Position	36
Figure 2.28: Comparison of Computed and Measured Ion Current Density in the 2.3kJ PF	37
Figure 2.29: Vickers Hardness Tester.....	38
Figure 2.30: Diamond Indenter in Vickers Hardness Tester	38
Figure 2.31: Vickers Indentation on Test Piece.....	40
Figure 2.32: Schematic of Radius versus Time Trajectories	45
Figure 2.33: Appearance of Lee Model Code in Microsoft Excel.....	46
Figure 2.34: The 5-point Fitting of Computed Current Trace to Measured (reference) Current Trace	47
Figure 3.1: Flow Chart of Experiment.....	49
Figure 3.2: Flow Chart of Test Samples Preparatio.....	51
Figure 3.3: Cutting of the Edges of Steel Pieces by Metal Horizontal Band Saw	52
Figure 3.4: Milling Process of Steel Pieces	53
Figure 3.5: Bench Grinder	53
Figure 3.6: Heating Temperature versus Time	54
Figure 3.7: Nabertherm Oven	54
Figure 3.8: Duration for Heating	55
Figure 3.9: Annealing Temperature.....	55
Figure 3.10: Time to Maintain Annealing Temperature at Constant.....	55
Figure 3.11: Microstructure of Steel Surface before Polishing and Grinding	56
Figure 3.12: Polishing and Grinding Process	56
Figure 3.13: Microstructure of Steel Surface after First Grinding.....	57
Figure 3.14: Polished AISI 1020 Carbon Steel with Mirror Surface Finished.....	57
Figure 3.15: Surface Microstructure of Steel with Mirror Surface Finished	57
Figure 3.16: Position of Vickers Hardness Measurement	58
Figure 3.17: Average Vickers Hardness Value before Nitriding.....	58
Figure 3.18: 3kJ Mather Type Plasma Focus Device	60
Figure 3.19: Schematic Diagram of UNU/ICTP PFF	61
Figure 3.20: Arrangement of Anode and Cathode in PF Device.....	61
Figure 3.21: Substrate Holder in Plasma Focus Device	62

Figure 3.22: Flow Chart of Firing Plasma Shot.....	63
Figure 3.23: Current and Voltage Waveform at 4.0 Torr	64
Figure 3.24: Current and Voltage Waveform at 0.5 Torr	65
Figure 3.25: Current and Voltage Waveform at 1.0 Torr	65
Figure 3.26: Current and Voltage Waveform at 1.5 Torr	66
Figure 3.27: Current and Voltage Waveform at 2.0 Torr	66
Figure 3.28: Structure of Rings Formation on Nitrided AISI 1020 Carbon Steel	68
Figure 3.29: Shape of Measured Current Trace before the Adjustment of Time Delay Factor and Magnification Factor.....	70
Figure 3.30: Shape of Measured Current Trace after the Adjustment of Time Delay Factor and Magnification Factor.....	71
Figure 3.31: Numerical Fitting of Computed Current Trace to Measured Current Trace	72
Figure 4.1: Appearance of AISI 1020 Carbon Steel after Nitriding (Sample 6)	73
Figure 4.2: Colour Counter for Surface Hardness of Sample 6 (1.0 Torr, 40mm axially from anode tip) : (a) before nitriding; (b) after nitriding	74
Figure 4.3: Colour Counter for Surface Hardness of AISI 1020 Carbon Steel	75
Figure 4.4: Schematic for Position of Measurement (indicated by 'x')	76
Figure 4.5: Graph of Average Surface Hardness at Epicenter at Different Nitrogen Gas Pressure.....	77
Figure 4.6: Graph of Percentage Difference of Surface Hardness at Epicenter at Different Nitrogen Gas Pressure.....	78
Figure 4.7: Graph of Surface Hardness along Epicenter Line : (a) Sample 1; (b) Sample 6; (c) Sample 11; and (d) Sample 16	80
Figure 4.8: Graph of Average of Highest Surface Hardness at Epicenter Line at Different Nitrogen Gas Pressure.....	82
Figure 4.9: Graph of Percentage Difference of Surface Hardness at Epicenter Line at Different Nitrogen Gas Pressure.....	83
Figure 4.10: Illustration of General Appearance of Nitrided Steel.....	84
Figure 4.11: Appearance of AISI 1020 Carbon Steel (a) before Nitriding and Nitrided at 40mm above Anode Tip with Nitrogen Pressure at (b) Sample 1 – 0.5 Torr; (c) Sample 6 – 1.0 Torr; (d) Sample 11 – 1.5 Torr; and (e) Sample 16 – 2.0 Torr	85
Figure 4.12: Appearance of AISI 1020 Carbon Steel after Nitriding under Different Conditions.....	87

Figure 4.13: Surface Microstructure of Unnitrided AISI 1020 Carbon Steel.....	88
Figure 4.14: Surface Microstructure of Sample 1.....	89
Figure 4.15: Surface Microstructure of Sample 6.....	89
Figure 4.16: Surface Microstructure of Sample 11.....	90
Figure 4.17: Surface Microstructure of Sample 16.....	90
Figure 4.18: Rusting on Sample 1.....	92
Figure 4.19: Formation of Steep Current Dip on Current Waveform at (a) 0.5 Torr; (b) 1.0 Torr; (c) 1.5 Torr; and (d) 2.0 Torr of Nitrogen Gas	94
Figure 4.20: Graph of Average Ion Beam Energy at Different Nitrogen Pressure.....	95
Figure 4.21: Graph of Average Ion Current at Different Nitrogen Pressure	97
Figure 4.22: Graph of Average Number of Ions per Shot at Different Nitrogen Pressure.....	98

LIST OF TABLES

Table 2.1: Determination of Annealing Temperature of AISI 1020 Carbon Steel.....	10
Table 2.2: Hardness Value along Nitrided Layer with Different Number of Shots	35
Table 2.3: Variation of Nitrogen Ion Beam Properties in 2.3 kJ PF at 1.25 mbar Nitrogen for Different Locations from the Tip of the Anode	36
Table 2.4: Recommended Test Force in ISO 6507-1	39
Table 3.1: Sample Identification of Experiment.....	50
Table 3.2: Parameters for Numerical Fitting	69
Table 4.1: Average Surface Hardness at Epicenter at Different Nitrogen Gas Pressure	76
Table 4.2: Average of Highest Surface Hardness at Epicenter Line at Different Nitrogen Gas Pressure.....	81
Table 4.3: Diameter of Center Ring of Different Nitrogen Pressure at 40mm above Anode Tip	86
Table 4.4: Parameters of Ion Beam Obtained by Lee Model Code	93

LIST OF ABBREVIATIONS

AFM	Atomic Force Microscope
EDX	Energy-Dispersive X-ray Spectroscopy
DPF	Dense Plasma Focus
PF	Plasma Focus
REB	Relativistic Electrons Beam
SEM	Scanning Electron Microscopy
SOP	Standard Operating Procedure
UNU/ICTP PFF	United Nation University/International Center for Theoretical Physics Plasma Focus Facility
XRD	X-ray Diffraction