

**THESIS**

**PIEZOELECTRIC SENSOR ON A SPEEDBUMP WITH  
COATING OF CARBON DOTS FROM OPEFB DOPED  
WITH ZINC FOR ELECTRICAL ENERGY  
GENERATION**



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**JAWA TIMUR**

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## ABSTRACT

This study aims to analyze the effect of load variation on the output performance of piezoelectric sensors, compare the performance of series and parallel circuit configurations, and evaluate the effectiveness of Zn-doped CDs derived from OPEFB as a coating material to enhance the mechanical performance of piezoelectric sensors for electrical energy generation. The design of a piezoelectric sensor prototype integrated into a speedbump system. Zn-doped CDs were synthesized using the sol-gel method and applied as a coating layer on the piezoelectric sensor using epoxy resin. The synthesized materials were characterized using XRD, SEM, and UV-Vis spectroscopy. Sensor performance testing was carried out using load variations on a single sensor sample as well as on series and parallel circuit configurations. The measured parameters included output voltage, current, and power under both AC and DC conditions. The performance evaluation demonstrated that the PLRCZ sample, consisting of a piezoelectric sensor coated with resin and Zn-doped CDs, produced the highest electrical output among all coating variations of  $8,21 \times 10^{-4} W$ . In addition, the parallel configuration generated the highest output of  $1 \times 10^{-2} W$ . The output voltage, current, and power increased with increasing applied load, indicating that the Zn-doped CDs coating improved pressure distribution and mechanical stability on the sensor surface.

Keywords: Piezoelectric sensor, Speedbump, Zn-doped CDs, OPEFB.

## PREFACE

Praise be to Allah SWT for the abundant blessings and grace, which have enabled the author to complete this thesis entitled **“Piezoelectric Sensor on a Speedbump with Coating of Carbon Dots from OPEFB Doped with Zinc for Electrical Energy Generation”** in a timely manner.

This thesis is submitted as a partial fulfillment of the requirements for obtaining a Bachelor of Science degree in the Physics Study Program, Faculty of Engineering and Science, Universitas Pembangunan Nasional “Veteran” Jawa Timur. Throughout the preparation of this thesis, the author has gained valuable experience, knowledge, and insights, both academically and non-academically.

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Surabaya, 8 April 2026

The Author

## TABLE OF CONTENTS

APPROVAL PAGE .....	ii
STATEMENT OF ORIGINALITY .....	iii
ABSTRACT .....	iv
PREFACE .....	v
TABLE OF CONTENTS .....	vii
LIST OF FIGURES.....	x
LIST OF TABLES .....	xii
LIST OF APPENDICES .....	xiii
CHAPTER 1 INTRODUCTION .....	1
1.1    Background .....	1
1.2    Problem Formulation .....	3
1.3    Research Objectives .....	3
1.4    Research Benefits.....	4
1.5    Hypothesis.....	4
CHAPTER 2 LITERATURE REVIEW .....	5
2.1    Piezoelectric Sensor .....	5
2.2    Effect of Series and Parallel Circuit Configurations on Piezoelectric Sensors .....	7
2.3    Speed Bump .....	11
2.4    Carbon-Dots Derived from Oil Palm Empty Fruit Bunches (OPEFB).....	11
2.5    Carbon-Dots as Energy Conversion Accelerators in Sensors .....	12
2.6    Characterization .....	13

2.6.1	X-Ray Diffraction (XRD) .....	13
2.6.2	Scanning Electron Microscopy (SEM) .....	14
2.6.3	Spektrophotometry Ultraviolet-Visible (UV-Vis).....	15
CHAPTER 3 RESEARCH METHODOLOGY .....		18
3.1	Research Approach .....	18
3.2	Research Variables.....	18
3.3	Research Methodology.....	19
3.3.1	Preparation of Equipment and Materials.....	19
3.3.2	Synthesis of Zn-Doped Carbon-Dots Using the Sol-Gel Method as a Coating for Piezoelectric Sensors .....	19
3.3.3	Assembly of Piezoelectric Sensors for Speed Bump Prototype.....	22
3.4	Characterization of Carbon-Dots Samples.....	23
CHAPTER 4 RESULT AND DISCUSSION .....		26
4.1	XRD Analysis of Piezoelectric Samples.....	26
4.2	XRD Analysis of Zn-Doped CDs .....	28
4.3	SEM Analysis of Zn-Doped CDs.....	29
4.4	UV-Vis Analysis of Zn-doped CDs .....	32
4.5	Piezoelectric Sensor Mechanism.....	33
4.6	Analysis of Single Piezoelectric Sensor Testing Data under Load Variations .....	35
4.7	Analysis of Series and Parallel Circuit Configuration Testing Data of the Piezoelectric Sensor Prototype under Load Variations.....	44
4.8	Correlation between the Overall Characterization Results of Zn-Doped CDs and the Performance of Piezoelectric Sensors as a Surface Coating .....	50

CHAPTER 5 CONCLUSIONS AND RECOMMENDATIONS .....	52
5.1    Conclusions .....	52
5.2    Recommendations .....	53
REFERENCES.....	54
APPENDICES.....	58
BIODATA.....	69

## LIST OF FIGURES

Figure 2.1 Two-Dimensional Configuration of Piezoelectric Crystals under Two Conditions, (a) Normal Condition, (b) Under Mechanical Deformation.....	6
Figure 2.2 Series Circuit Configuration of Piezoelectric Sensors.....	7
Figure 2.3 Parallel Circuit Configuration of Piezoelectric Sensors .....	7
Figure 2.4 The fundamental principle of XRD .....	13
Figure 2.5 SEM Image of the Morphological Structure of Sugar Factory Waste.....	15
Figure 2.6 UV–Vis Spectrum of Benzene.....	16
Figure 3.1 Synthesis of Zn-Doped Carbon Dots (CDs) and Their Coating on Piezoelectric Sensors.....	20
Figure 3.2 Coating Layer Details on the Surface of the Piezoelectric Sensor, (A) Front View, (B) Side View .....	21
Figure 3.3 Two Configurations of Piezoelectric Sensors, (A) Series Circuit, (B) Parallel Circuit.....	22
Figure 3.4 Design of the Piezoelectric Sensor System as a Speed Bump Prototype ..	23
Figure 3.5 Research Flowchart .....	25
Figure 4.1 XRD Measurement Spectrum of Piezoelectric Samples .....	26
Figure 4.2 XRD Measurement Spectrum, (A) CDs Sample from OPEFB, (B) Zn-Doped CDs Sample .....	28

Figure 4.3 SEM Characterization Results of Zn-Doped CDs, (A) SEM Image at 10K Magnification, (B) Backscattered Electron Image at 10K Magnification Analyzed Using ImageJ Software, (C) Particle Size Distribution Analysis of the Sample .....	29
Figure 4.4 (A) Manual Measurement of Particle Diameter Using ImageJ on The Zn-doped CDs Sample, (B) Autosystem Measurement Results of the Particle Diameter of The Zn-doped CDs Sample using ImageJ.....	31
Figure 4.5 UV-Vis Characterization Results of Zn-Doped CDs.....	32
Figure 4.6 Band Gap Energy of Zn-Doped CDs.....	32
Figure 4.7 Piezoelectric Sensor, (A) Without Coating, (B) With Resin Coating, (C) With EFB-Derived CDs Coating, (D) With Zn-Doped CDs Coating.....	33
Figure 4.8 Single Piezoelectric Sensor Samples with Coating Variations, (A) PTL Sample, (B) PLR Sample, (C) PLRC Sample, and (D) PLRCZ Sample .....	35
Figure 4.9 Comparison Graph of Calculated and Experimental DC Output Voltage, (A) PTL, (B) PLR, (C) PLRC, (D) PLRCZ.....	41
Figure 4.10 Graph of AC–DC Voltage Output Comparison, (A) 500 g Load, (B) 1 kg Load, (C) 1.5 kg Load, (D) 2 kg Load .....	41
Figure 4.11 Testing of a Single Piezoelectric Sensor Sample with Load Variations, (A) 500 g Load, (B) 1 kg Load, (C) 1.5 kg Load, and (D) 2 kg Load.....	42
Figure 4.12 Prototype Configuration of Piezoelectric Sensors, (A) PTL Series Circuit, (B) PLRCZ Series Circuit, (C) PTL Parallel Circuit, (D) PLRCZ Parallel Circuit ....	44
Figure 4.13 Comparison of Power Output Results of the PLRCZ Configuration at 2 Hz .....	50
Figure 4.14 Testing of Series and Parallel Configurations of PTL and PLRCZ Samples with Load Variations, (A) 1 kg Load, (B) 2 kg Load, (C) 3 kg Load.....	50

## LIST OF TABLES

Table 2.1 Piezoelectric Sensor Material.....	5
Table 2.2 Summary of Previous Studies on Piezoelectric Sensors.....	8
Table 3.1 Research Variables.....	18
Table 3.2 Nomenclature of Piezoelectric Sensor Samples.....	21
Table 4.1 Phase Composition Results of Piezoelectric Samples .....	26
Table 4.2 Particle Size Distribution of Zn-Doped CDs Samples.....	31
Table 4.3 $V_{DC}$ Conversion Results.....	40
Table 4.4 Average Results of Single-Element Piezoelectric Sensor Testing under Alternating Current (AC).....	43
Table 4.5 Average Results of Single-Element Piezoelectric Sensor Testing under Direct Current (DC).....	43
Table 4.6 Average Results of Series Circuit Configuration Testing of Piezoelectric Sensors .....	48
Table 4.7 Average Results of Parallel Circuit Configuration Testing of Piezoelectric Sensors .....	49

## LIST OF APPENDICES

Appendices A. XRD Characterization Results of Piezoelectric Samples from Match! .....	58
Appendices B. XRD Characterization Results of Zn-Doped CDs Samples from Match! .....	58
Appendices C. Measurement of Zn-Doped CDs Sample Diameter Based on SEM Analysis.....	59
Appendices D. Excel Data of Autosystem Results from ImageJ Measurement of Particle Size Distribution of Zn-Doped CDs Sample .....	59
Appendices E. Sol-Gel Synthesis Process of Zn-Doped CDs Samples .....	60
Appendices F. Result of Sol-Gel Synthesized of Zn-Doped CDs Powder .....	60
Appendices G. Damaged PTL Configuration .....	60
Appendices H. Damaged PTL Elements.....	60
Appendices I. Repetition Test of a Single Sensor Element PTL .....	61
Appendices J. Repetition Test of a Single Sensor Element PLR.....	62
Appendices K. Repetition Test of a Single Sensor Element PLRC.....	63
Appendices L. Repetition Test of a Single Sensor Element PLRCZ.....	64
Appendices M. Repetition Test of Series Configuration PTL .....	65
Appendices N. Repetition Test of Series Configuration PLRCZ .....	66
Appendices O. Repetition Test of Parallel Configuration PTL .....	67
Appendices P. Repetition Test of Parallel Configuration PLRCZ.....	68