EFFECT OF STATIC ELECTRIC FIELD ON LASER INDUCED BREAKDOWN SPECTROSCOPY

(16, bold all letters capital, TNR)

Sehrish Kanwal

(14, bold, First letter capital, TNR)

(MUST/FA16-RPH-015/AJK)

(14, bold, TNR)

Session 2016-2018

(14, bold, TNR)

Department of Physics

Faculty of Natural and Applied Sciences

Mirpur University of Science and Technology (MUST), Mirpur

AJK Pakistan **(14 bold, First letter capital, TNR)**

EFFECT OF STATIC ELECTRIC FIELD ON LASER INDUCED BREAK DOWN SPECTROSCOPY

(16, bold all letters capital, TNR)

By
(14, TNR, Normal)

Sehrish Kanwal
(14, bold, First letter capital, TNR)

(MUST/FA16-RPH-015/AJK)
(14, bold all letters capital, TNR)

A thesis is submitted in partial fulfillment of
the requirement for the degree of (14, Normal, TR)

MASTER OF PHILOSOPHY

In

PHYSICS
(14, bold all letters capital, TNR)

Session 2016-2018
(14, Normal, TR)

Department of Physics

Faculty of Natural and Applied Sciences

Mirpur University of Science and Technology (MUST), Mirpur

(AJK) Pakistan

CERTIFICATION

I hereby undertake that this research is an original one and no part of this thesis falls under plagiarism. If found otherwise, at any stage, I will be responsible for the consequences. (Normal, 12, TNR, line space 1.5)

Student's Name: **Sehrish Kanwal** Signature: _____

Registration No.: **MUST/FA16-RPH015/AJK** Date:_____

Certified that the contents and form of thesis entitled "**Effect of Static Electric Field on Laser Induced Breakdown Spectroscopy of *Calotropis Procera* Plant**" submitted by "**Sehrish Kanwal**" have been found satisfactory for the requirement of the degree.

Supervisor: _____
(Prof. Dr. Muhammad Irshad)

Co-Supervisor: _____
(Prof. Dr. Muhammad Farooq)

Member: _____
(Dr. Muhammad Tariq)

Member: _____
(Dr. Ansar Ahmed)

Date of Defense:_____ External Examiner: _____

Chairperson: _____

Dean: _____

Director,
Advanced Studies & Research Board: _____

CERTIFICATE OF APPROVAL

This is to certify that the research work presented in this thesis, entitled "**Write the approved thesis title from advanced studies and research board in times new roman with font size 12 and bold**." was conducted by Mr. **Name of the Student** under the supervision of **Name of Approved Supervisor**.

No part of this thesis has been submitted anywhere else for any other degree. This thesis is submitted to the Department of **Department Name** in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Field of **Subject Name,** Department of: **Department Name**

University of: **Mirpur University of Science and Technology, Mirpur**

Student Name: _____ Signature: _____
Registration No.:

Examination Committee:

a) External Examiner: Name (Designation & Office Address) Signature:_____

……..

……..

Supervisor Name: Signature:_____

Name of Chairperson: Signature:_____

Name of Dean: Signature: _____

Plagiarism Undertaking

I solemnly declare that research work presented in the thesis titled "……

……"

is solely my research work with no significant contribution from any other person. Small contribution/help wherever taken has been duly acknowledged and that complete thesis has been written by me.

I understand the zero tolerance policy of the HEC and University

Mirpur University of Science and Technology (MUST)

towards plagiarism. Therefore I as an Author of the above titled thesis declare that no portion of my thesis has been plagiarized and any material used as reference is properly referred/cited.

I undertake that if I am found guilty of any formal plagiarism in the above titled thesis even after award of PhD degree, the University reserves the rights to withdraw/revoke my PhD degree and that HEC and the University has the right to publish my name on the HEC/University Website on which names of students are placed who submitted plagiarized thesis.

Student /Author Signature:_____ Date: _____

Name:_____

Author's Declaration

I _____hereby state that my PhD thesis titled _____

_____

is my own work and has not been submitted previously by me for taking any degree from this University

Mirpur University of Science and Technology (MUST)

Or anywhere else in the country/world.

At any time if my statement is found to be incorrect even after my Graduate the university has the right to withdraw my PhD degree.

_____

(Name of Student)

Date:

DEDICATION

(Heading font 14, TNR, Bold with first letter capital)

Text

(TNR)

CONTENTS

Page No.

LIST OF FIGURES

Figure No. **Page No.**

LIST OF TABLES

COPY RIGHTS (14 BOLD,TNR)

(ADD THIS PAGE, IF YOU HAVE ORGINAL RESEARCH DATA WHICH HAVE NOT BEEN YET PUBLISHED)

ACKNOWLEDGMENTS

(Heading Font 14, TNR, Bold and all capital)

Text

(Font size 12, TNR, Normal)

Muhammad Umer

ABSTRACT

(ALL TEXT, NROMAL, TNR,12, LINE SPACE 1.5, PARAGRAPHS INDENTED)

The technique of laser-induced breakdown spectroscopy (LIBS) for quantitative elemental analysis of materials, has applied to leaves, stem and root of Calotropis procera plant collected from Mirpur Azad Kashmir. LIBS plasma is generated by a 1064 nm pulsed Nd: YAG laser. With and without effect of the electric field the time-resolved neutral and ionic spectral lines of aluminium (Al), barium (Ba), copper (Cu), calcium (Ca), cobalt (Co), ferrous (Fe), hydrogen (H), potassium (K), magnesium (Mg), manganese (Mn), sodium (Na), nitrogen (N), oxygen (O) and silicon (Si) from the LIBS spectra has recorded. It has detected using aventus detection system. Using a Nd: YAG laser with a 10 ns pulse duration, LIBS is performed by using electric field on a plant sample shows several LIBS spectra, focusing primarily on Ca and Mg lines. A gradual increase in LIBS intensity is observed when electric field 300V/3mm is used. Without using electric field gives different intensities of elements but resulted in a significant decrease in LIBS emission intensity and significant decrease in spectral intensity of ionic species without using electric field, suggesting a rapid decrease in electron density. The electron number densities are calculated by using standard equations of Stark Broadening for the spectral line of calcium at 422.67 nm wavelength and plasma temperature by using Boltzmann plot method. The Boltzmann distribution and experimentally measured lines intensities support that the plasma is in local thermal equilibrium. The comparison of root, leave and stem sample expose the presence of (Ca, Mg, K, Si, Al, Sr and Na) in all samples by using LIBS. Using electric field, advantages are higher spectral resolution, greater S/N, and increased spectral intensity.

Chapter 01

INTRODUCTION

1.1 HISTORY OF SPECTROSCOPY

Spectroscopy and spectrograph are terms used to refer the estimation of produced radiations as an element of wavelength. In 1666, Isaac Newton depicted entry of white light through crystal in his trial discourse and found that white light could be partitioned into its segment wavelengths. (**TNR, 12,Normal, line spacing 1.5**)

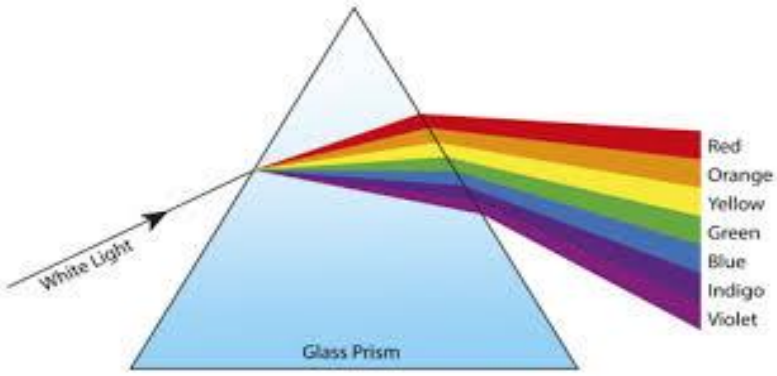

Figure 1.1: Splitting of sunlight into seven colors

Amid mid 1800's Wollaston watched that dark lines were available amid the examination of sun’s solar spectrum. In 1814 Fraunhofer additionally examined these dark lines in the sun's spectrum and saw more than 700 of them.

1.2 LASER SPECTROSCOPY

Laser have a progressive impact in optical spectroscopy since mid-1960's. Laser spectroscopy is a spectroscopic system that uses lasers to evaluate the radiated frequencies of matter.

1.3 LASER INDUCED BREAKDOWN SPECTROSCOPY (LIBS)

Laser induced breakdown spectroscopy is a diagnostic method that is utilized to examines the subjective and quantitative essential examination.

Chapter 02

MATERIALS AND METHODS

In the past section I have talked about, the history of Spectroscopy along with its types, methods, optical instrumentation and its applications with merits and demerits. Laser Induced Breakdown Spectroscopy is also discussed with its applications, benefits and negative marks. The plasma formation and its generation mechanisms, line profile and diverse variables affecting the lines profile have talked about in section first. The detail of medicinal plant which we have utilized for LIBS study has likewise given in first section.

2.1 EXPERIMENTAL DETAIL

By using LIBS setup we study the emission spectra of Calotropis Procera. The solid samples of the plant i.e. leaves, stem and roots in the form of pellets are used.

2.2 ND-YAG LASER

Keeping in mind the end goal to create plasma plume on pallets we use Q-switched Nd: YAG laser. We want to use it because it is easy to control and has high irradiance and accuracy. Nd: YAG laser has four level schemes.

2.2.1 Structure of Laser

The bars of Nd: YAG laser is mostly of 10cm long and has 12mm diameter. A linear flash lamp and Nd: YAG rod are accommodate in a reflector cavity of elliptical cross-section. The light emitting from the lamp is firmly joined to the laser rod since they are set at the foci of the ellipse.

Chapter 03

RESULTS AND DISCUSSION

The fundamental ideas of spectroscopy, spectra and it's compose, laser induced breakdown spectroscopy (LIBS) and its applications have talked about in first and second chapter.

3.1 ELECTRON DENSITY

The knowledge of electron density is an important parameter in plasma because the efficiency of the physical phenomena occurring in the plasma and their reaction rates are generally depending directly on density of electrons. Aluminum in a humid air to measure electron density using H_α line. Process was completed using several time delays but fix gate to obtain several values.

Table 3.1: Spectroscopic data of Ca use in the Boltzmann plot for leaf with electric field

Energy (cm^{-1})	**Intensity I(a.u)**	**Wavelength λ(nm)**	**Statistical Weight (gk)**	**Transition Probability A_{kj}**
23652.3	26599.75	422.676	3	2.18E+08
38551.56	5038.907	428.273	5	4.34E+07
38464.81	5430.745	428.929	3	6.00E+07
38464.81	3381.023	429.91	3	4.66E+07

CONCLUSIONS **(ALL CAPITAL, 14 BOLD`, TR)**

(FOR TEXT 12,TR,NORMAL, 1.5 LIEN SPACING)

Laser induced breakdown spectroscopy technique with static electric field effect has used to find elemental composition of leaves, stem and root. With and without effect of the electric field the time-resolved neutral and ionic spectral lines of aluminum (Al), barium (Ba), copper (Cu), calcium (Ca), cobalt (Co), ferrous (Fe), hydrogen (H), potassium (K), magnesium (Mg), manganese (Mn), sodium (Na), nitrogen (N), oxygen (O) and silicon (Si) from the LIBS spectra has been recorded.

FUTURE PROSPECTS

(IF REQUIRED TEHN ADD, OTEHRWISE DELETE IT)

REFERENCES

(ALL CAPITAL, BOLD, 14, TR)

NOTE: FOR REFERENCE STYLE, FOLLOW YOUR DEPARTMENTAL'S POLICY AND ASK YOUR SUPERVISER, BUT STYLE OF ALL REFERNCES SHOULD BE SAME)

(FONT TNR, SIZE 12, LINE SPACE 1.5)