

EFFECT OF STATIC ELECTRIC FIELD ON LASER INDUCED BREAKDOWN SPECTROSCOPY

(16, bold all letters capital, TNR)



Shrish 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
(bold, all capitals, 14, TNR)

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 Anwar)

Co-Supervisor: _____
(Dr. Engr. Muhammad Ali)

External Examiner: _____

Date of Viva Voice: _____

Chairperson: _____

Dean: _____

Director,
Advanced Studies & Research Board: _____

DEDICATION

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

Text
(TNR)

CONTENTS

	Page No.
Table of Figures	v
List of Tables.....	vi
ABSTRACT	vii
1. INTRODUCTION	1
1.1 HISTORY OF SPECTROSCOPY	5
1.2 LASER SPECTROSCOPY	6
1.3 LASER INDUCED BREAKDOWN SPECTROSCOPY (LIBS)	8
1.3.1 Improvement of LIBS	10
1.3.2 Plasma Production from Solid Targets	11
2. MATERIALS AND METHODS	12
2.1 EXPERIMENTAL DETAIL.....	15
2.2 ND-YAG LASER	15
2.2.1 Structure of Laser	18
2.3 OPTICAL FIBER.....	Error! Bookmark not defined.
3. RESULTS AND DISCUSSION	33
3.1 PREVIOUS WORK	34
CONCLUSIONS	48
REFERENCES	59

LIST OF FIGURES

Figure No.	Page No.
1.1: Splitting of sunlight into seven colors	1
1.2: Light matter interaction	5
1.3: Laser ablation process.....	8

LIST OF TABLES

Table No.		Page No.
3.1	Spectroscopic data of Ca used in the Boltzmann plot for leaf	25

COPY RIGHTS (14 BOLD,TNR)

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

THE DATA AND RESULTS REPORTED IN THE TEHSIS HAS NOT BEEN
PUBLISHED OR SHARED YET AND PROTECTED BY COPY RIGHTS
OWNED BY UNIVERSITY AND PROHABITED TO USE FOR ANY PRUPOSE
WITHOUT PERMISSION.

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

Text
(Font size 12, TNR, Normal)

Amir Ali Khan

ABSTRACT

(ALL TEXT, NORMAL, 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, leaf 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.

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)

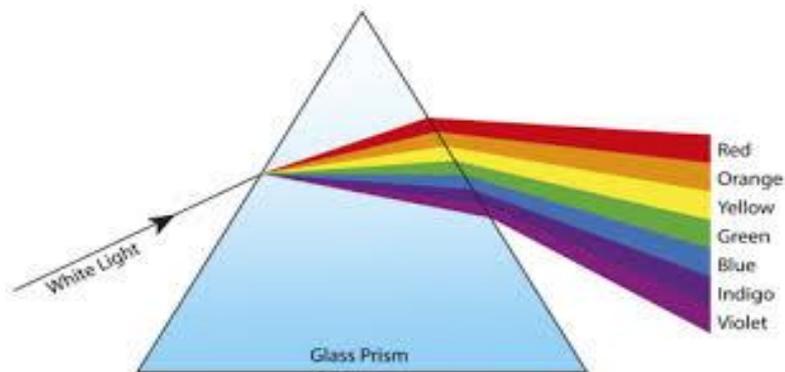


Figure 1.1: Splitting of sunlight into seven colors

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.

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.

RESULTS AND DISCUSSION

The fundamental ideas of spectroscopy, spectra and its 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 $\lambda(\text{nm})$	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)