International Journal of Academic Engineering Research (IJAER)
ISSN: 2643-9085
Vol. 5 Issue 11, November - 2021, Pages: 29-32

Effect of Different Laser Power on Detecting Elements for Dates Fruits (Gondela) Using Laser Induced Breakdown Spectroscopy (LIBS)

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Abstract: *In this work laser-induced breakdown spectroscopy (LIBS) has been used to identify the elements that contains in dates fruits (Gondela) which collected from Goshabi Governorate in Northern Sudan. The sample was exposed to pluses nitrogen laser 337.1nm with power (100, 200) mJ and duration 10ns. The obtained results showed that the Gondela dates fruits contains considerable amount of elements when used power 100mJ such as Xe II, WI , Fe II, Zn I, Ar I, Cu II ,Na II , Ne II , Cr I and Th I, while W I , Xe II , Fe II , Mo I, Na II , Ne II , Mg II , Ra I , Th I , Xe I , V I , Ti I , Fe I , Mn I , V II, Co II and K I when used power 200mJ.*

Keywords: LIBS, Gondela, Nitrogen Laser and Power.

Introduction

Laser Induced Breakdown Spectroscopy (LIBS) is a quasi-non-destructive technique that operates on the fundamental principle of the ablation of a small amount of sample by a laser pulse that is focused onto the surface. The ablated material then forms a plasma of excited atoms, ions, and free electrons that, on cooling, emits radiation at characteristic wavelengths dependent upon the elemental composition of the sample. Increasingly, LIBS is being recognized as a promising technique for elemental analysis, including in industry [1]. Examples of use include: elemental analysis in space exploration programs [2], quality control use in pharmaceuticals [3], and forensic and archaeological sample analysis [4].This diverse range of LIBS applications is largely driven by the technique's capability to perform fast, multi-elemental analysis of solids[5], liquids [6], and gases [7], with virtually no sample preparation, and with low ppm sensitivity .LIBS is also used in the nuclear industry as the technique permits standoff analysis of radioactive samples at millimeter to 10s of meters of distance. Therein, a rapidly emerging application is elemental analysis of radioactive waste processing materials for the assessment of radionuclide contamination. Positive identification of fission products, actinides, and activated corrosion products has been demonstrated for a range of nuclear materials, including mixed oxide fuels [8], molten salt electrolytes [9], and graphite [10].LIBS has also been used for analysis of nuclear plant steels; however ,work here has focused on analysis of steel alloying components for quality control during manufacturing [11,12], or for discrimination between different kinds of steel for the rapid identification and sorting of unknown materials [13,14]. To our knowledge, LIBS has not been used to quantify radionuclide uptake onto steel components.

Experimental

Gondela dates fruits which collected from (Goshabi) in North Sudan was exposed to N_2 Laser with power (100,200) mJ within Laser-induced breakdown spectroscopy set up as shown in figure (1), which consists of Nitrogen laser, optical system (convex lens (f=10cm) and mirror (7.4×4.7cm)), sample container which is made of quartz, optical fiber, detection system (USB2000 Spectrometer) in addition to Computer with ocean optic software and origin9 program. The recorded data was calibrated using the national institute of standards and technology (NIST database).

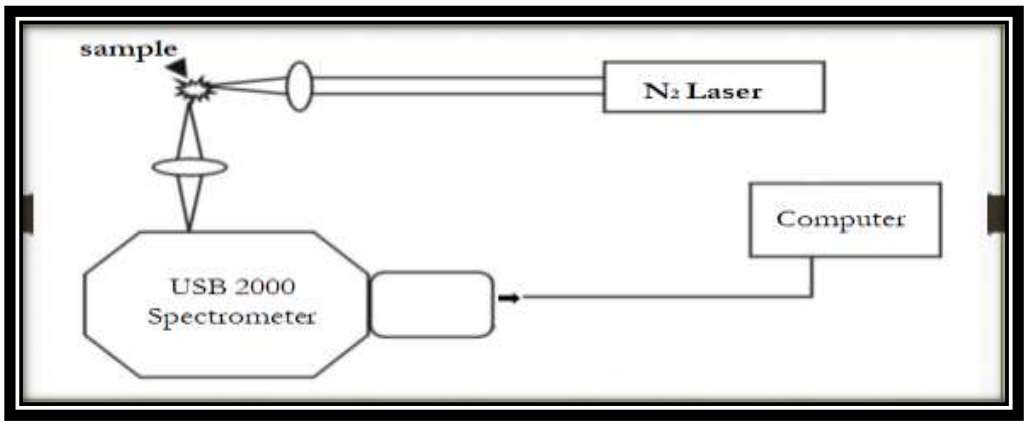

Figure (1) Schematic diagram of Laser-induced breakdown spectroscopy (LIBS) experimental setup.

Results and discussion

The LIBS emissions spectra of Gondela date fruit were illustrated in figures (2) and (3) and the elements obtained after calibration of wavelength with NIST database were showed in table (1) and (2).

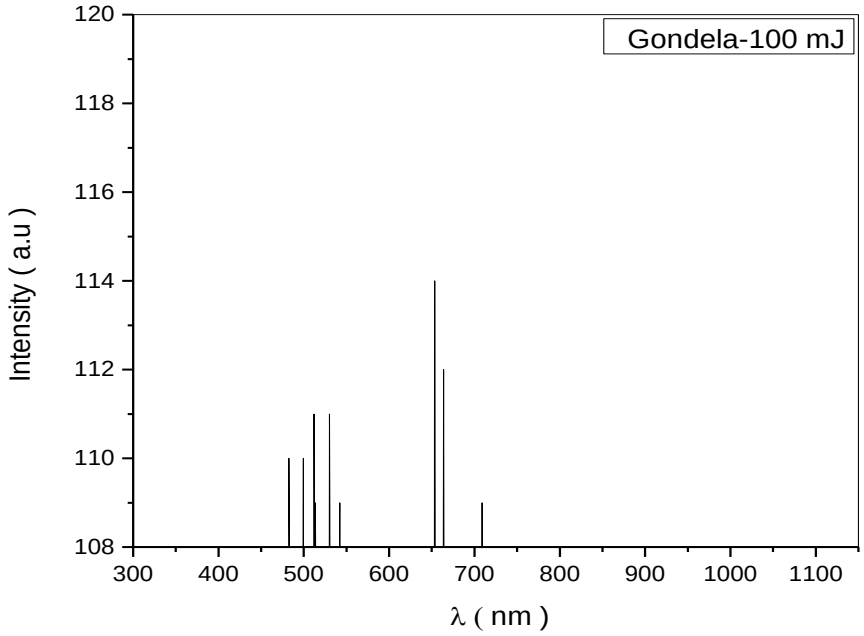

Figure (2) LIBS emission spectra for Gondela using N_2 Laser 100mJ

Table (1): the obtained data for LIBS emission spectra of Gondela using N_2 Laser 100mJ

Element	Wavelength(nm)	Intensity(a.u)	Element	Wavelength(nm)	Intensity(a.u)
Xe II	483.2222	110.0106	Na II	652.4666	113.7573
W I	499.0888	109.9344	Ne II	653.9777	113.3704
Fe II	511.9333	111.1540	Cr I	663.8	112.1770
Zn I	531.2	109.9606	Th I	513.4444	109.1016
Ar I	542.1555	109.1278		529.3111	110.9049
Cu II	708.3777	109.1016			

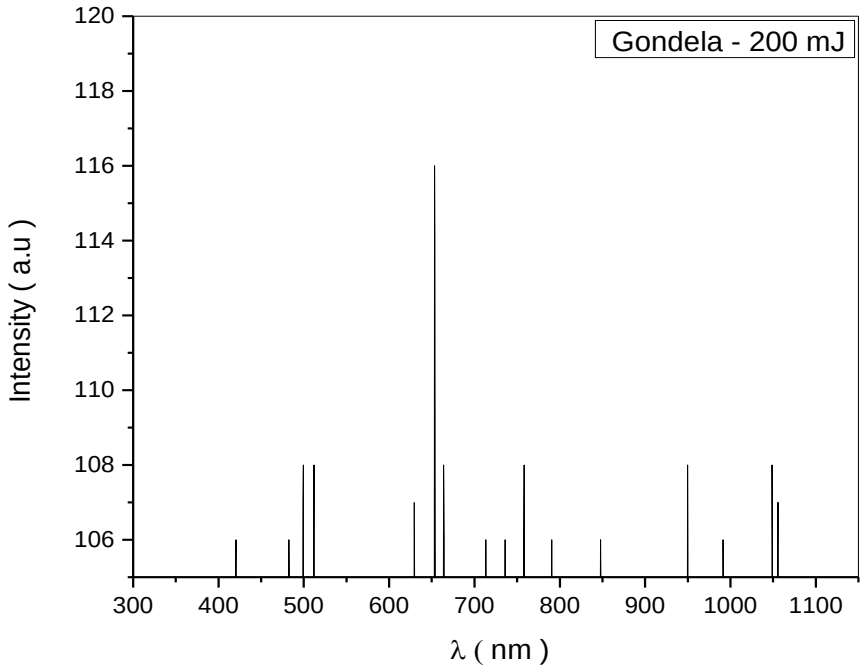

Figure (3) LIBS emission spectra for Gondela using N_2 Laser 200mJ

Table (2): the obtained data for LIBS emission spectra of Gondela using N_2 Laser 200mJ

Element	Wavelength(nm)	Intensity(a.u)	Element	Wavelength(nm)	Intensity(a.u)
W I	420.8888	106.3114	Th I	711.7777	105.8934
	499.0888	107.9754	Xe I	735.5777	106.0327
Xe II	483.2222	105.1934	V I	757.8666	108.1665
Fe II	511.9333	107.9754	Ti I	789.9777	106.1721
Mo I	630.1777	106.5491	Fe I	791.4888	106.1311
Na II	652.4666	115.9426	Mn I	847.4	106.0655
Ne I	653.9777	115.5245	V II	949.7777	108.2868
Mg II	683.800	108.2868	Co II	991.3333	106.2049
Ra I	665.3111	106.5491	K I	1048.7555	107.9754
	628.6666	106.000	Ti I	1055.17777	107.1393

Figure (2) and (3) display LIBS emission spectra of Gondela date fruit when exposed to 100mJ and 200mJ of N_2 laser, from table (1), the elements that appeared when Gondela exposed to N_2 laser with power 100mJ were Xe II, WI , Fe II, Zn I, Ar I, Cu II ,Na II , Ne II , Cr I and Th I, but with power 200mJ the appeared elements were W I , Xe II , Fe II , Mo I, Na II , Ne II , Mg II , Ra I , Th I , Xe I , V I , Ti I , Fe I , Mn I , V II, Co II and K I when used power 200mJ, this refer to the fact of increasing in laser power generate more plasma from sample and thus the detection will be in a wider range.

Conclusion

The elements present in Gondela date fruit were determined using Laser Induced Breakdown Spectroscopy in different power of N_2 laser (100 and 200) mJ, the elements detected by power 100mJ less than detected by power 200mJ, this means the increasing in laser power make the detection in broad range.

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