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Identification Of Java Agate Elements Using Libs Methods

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Abstract – Agate is a stone that is created due to natural processes from the deposition of fossils and the formation of minerals that combine to become an agate. In essence, agate contains elements contained therein. The content of these elements can be used to distinguish the type of agate. Several methods are used to detect the elemental content of agate, including X-Ray Fluorescence and X-Ray Diffraction methods. In this study, agate will be tested using the LIBS method. The LIBS method is an alternative and effective method for identifying elements from a sample because this method does not require the sample to receive special treatment. Laser plasma optimization is done by varying the laser energy. The higher the value of the laser energy given, the intensity of the elemental spectrum will be higher. The results of the LIBS method show compatibility with the XRF method as a comparative study. The results showed that the elements contained in the agate are the elements Al, Mn, Si, Fe, Mg, Na, and Ca.

Keywords – Agate, LIBS, Spectroscopy

I. Introduction

Agate or agate is a stone that is created due to natural processes from the deposition of fossils and the formation of minerals that combine to become an agate or gem. In general, people distinguish the types of agate by looking at physical characteristics such as color, texture, and motifs or patterns on agate. In essence, agate contains elements contained therein. The content of these elements can be used to distinguish the type of agate. Of course, the content of these elements can be detected using spectroscopic methods. Some of the methods used are the X-Ray Fluorescence and X-Ray Diffraction methods. Such absorption is a characteristic of the gemstone material, the molecular structure, and extraneous impurities or inclusions within the crystalline structure [1]. There are several methods for analyzing elemental content in gemstones such as X-Ray Fluorescent (XRF). This method requires that the sample get special treatment first as it is crushed into powder form. The weakness of the XRF method is that the sample cannot be reused because it has already become another form. To overcome these weaknesses, the Laser Induced Breakdown Spectroscopy method was used in this study. With the LIBS method, spectrums will emerge that indicate the characteristics of a particular element. One of the advantages of this method is that no special treatment is needed in the sample preparation [2]. In this study, the LIBS method was used to quickly identify the elemental content of Javanese agate. To produce an optimal spectrum of elemental content, namely a spectrum that has high intensity with low noise emission and background emission, a laser energy variation test was carried out.

II. Method

The advantage of this method is that when you get results you can match them directly to an online database [3-4]. The laser used in this study was pulse Nd:YAG laser with a wavelength of 1064 nm, energy of 45 mJ, and a pulse width of 7 ns. The variation of energy of the laser was set at 40 mJ, 42,5 mJ, and 47,5 mJ. The environmental pressure used corresponds to atmospheric pressure. The experimental setup used in this study is shown in Fig. 1. The laser beam is fired on the sample surface through reflection from a silver mirror and then focused through a focusing lens with a focal length of 30 mm. A luminous plasma was then produced due to the interaction of the laser with the sample target. Plasma was then captured by optical fiber and sent to an optical multichannel analyzer (OMA). OMA converted the captured plasma into a spectrum graph. Spectrum is characteristic of the elements in the sample. The peak intensity of the spectrum was matched with the National Institute of Standards and Technology (NIST) database to obtain the elemental content contained in the sample [5].

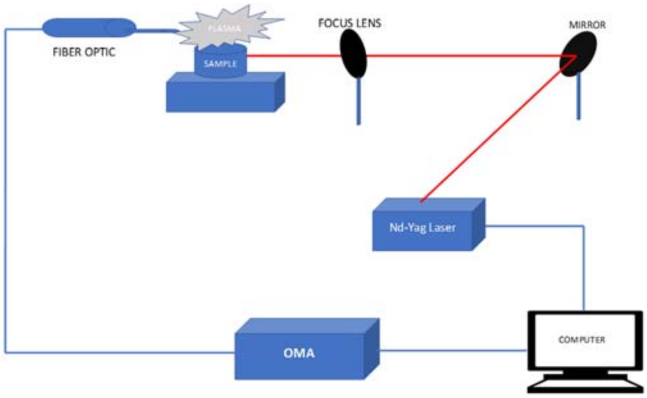

Fig. 1. Experimental Set-Up

III. Results And Discussion

Figures 2, 3, and 4 show a comparison of firing Javanese agate samples at energies of 40 mJ, 42.5 mJ, and 47.5 mJ. From the spectrum graph obtained, the value of laser energy affects the intensity of the spectrum for each variation of laser energy. The higher the value of the laser energy given to the sample, the higher the resulting spectrum intensity value.

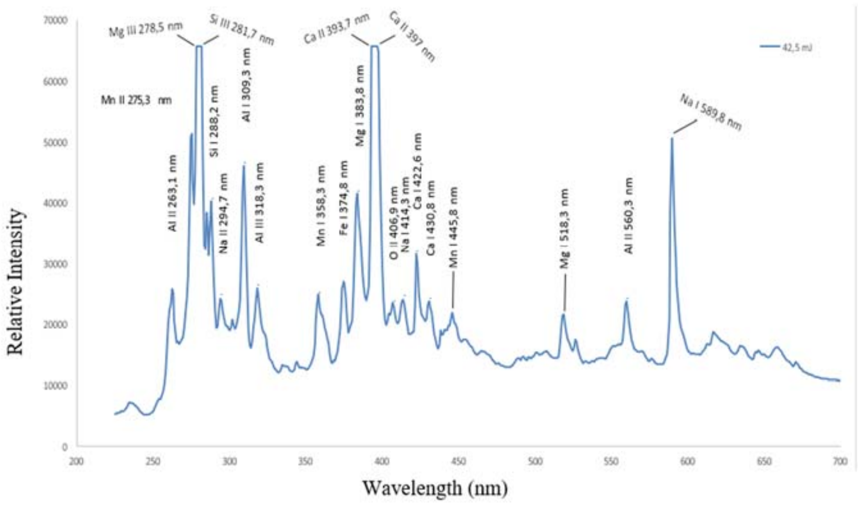

Fig. 2. Elemental spectrum of Javanese agate using energy 40 mJ

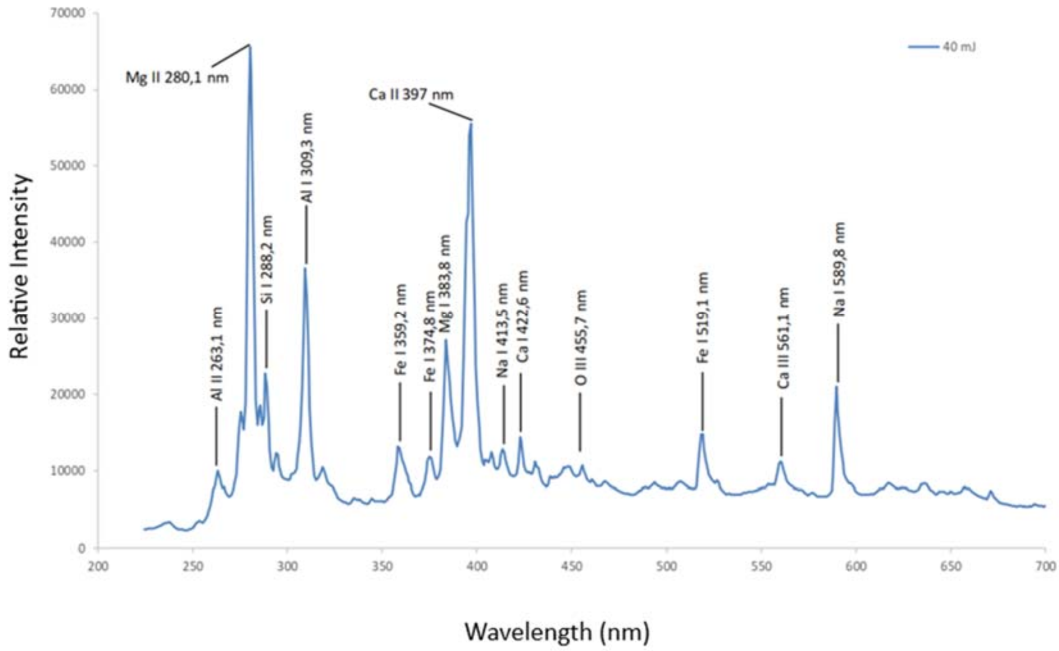

Fig. 3. Elemental spectrum of Javanese agate using energy 42,5 mJ

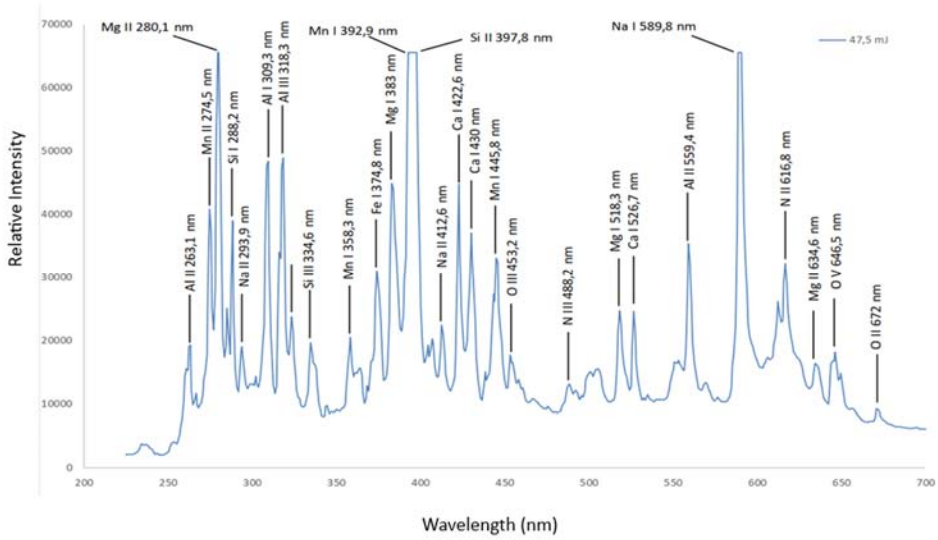

Fig. 4. Elemental spectrum of Javanese agate using energy 47,5 mJ

Figure 2 shows the spectrum of elements contained in Javanese agate with an energy of 40 mJ detected by OMA. The wavelengths that appear on the graph with an energy of 40 mJ are Al II 263.1 nm, Mg II 280.1 nm, Si I 288.2 nm, Al I 309.3 nm, Fe I 359.2 nm, Fe I 374, 8 nm, Mg I 383.8 nm, Ca II 397, Na I 413.5 nm, Ca I 422.6 nm, O III 455.7 nm, Fe I 519.1 nm, Ca III 561.1 nm, and NaI 589.8 nm.

Figure 3 shows the spectrum of elements contained in Javanese agate with an energy of 42.5 mJ detected by OMA. The wavelengths that appear on the graph with an energy of 42.5 mJ are Al II 263.1 nm, Mn II 275.3 nm, Mg III 278.5 nm, Si III 281.7, Si I 288.2 nm, Na II 294 .7 nm, Al I 309.3 nm, Al III 318.3 nm, Mn I 358.3 nm, Fe I 374.8 nm, Mg I 383.8 nm, Ca II 393.7 nm, Ca II 397 nm, O II 406.9 nm, Na I 414.3 nm, Ca I 422.6 nm, Ca I 430.8 nm, Mn I 445.8 nm, Mg I 518.3 nm, Al II 560.3 nm, and Na I 589.8 nm.

Figure 4 shows the spectrum of elements contained in Javanese agate with an energy of 47.5 mJ detected by OMA. The wavelengths that appear on the graph with an energy of 47.5 mJ are Al II 263.1 nm, Mn II 274.5 nm, Mg II 280.1 nm, Si I 288.2 nm, Na II 293.9 nm, Al I 309.3 nm, Al III 318.3 nm, Si III 334.6 nm, Mn I 358.3 nm, Fe I 374.8 nm, Mg I 383.8 nm, Mn I 392.9 nm, Si II 397 .8 nm, Na II 412.6 nm, Ca I 422.6 nm, Ca I 430 nm, Mn I 445.8 nm, O III 453.2 nm, N III 488.2 nm, Mg I 518.3 nm, Ca I 526.7 nm, Al II 559.4 nm, Na I 589.8 nm, N II 616.8 nm, Mg II 634.6 nm, O V 646.5 nm, and O II 672 nm.

IV. Conclusions

The effect energy of the laser in the identification of elements in the gemstone Agate stone sample using the LIBS technique can be seen through the visual plasmas and their emission spectra. Spectrum graphs produced from variations in the variation of energy show differences in relative intensity. The higher energy used, the higher the relative intensity produced. The results confirmed that the elements identified in the LIBS technique are the same as the elements obtained by the XRF technique.

Acknowledgment

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