MEASUREMENT THE FLUORESCENCE PARAMETERS OF THE OLIVE OIL AND COMPARING IT WITH SOME LASER DYE MATERIALS

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ABSTRACT

The verse (35) in SURA (AL- Nur) in the HOLY QURAN has inspired the author to look into the possibility of using Olive Oil as active dye laser material. Olive Oil which is classified as organic compound, having a good properties candidate it to be used as active dye laser material. The emission spectrum diagrams at some of absorption peaks (414, 536, 632 and 670) nm will be measured. These diagrams have been used to determine the Fluorescence quantum yield, Oscillator strength, Einstein coefficients for the spontaneous emission, Radiative and Fluorescence lifetime and absorption and cross sections. It has been found that fluorescence occurs at 669 nm for the entire absorption spectrum. Fluorescence of Olive Oil has been experimented using 30mW, 532nm semiconductor laser, with a beam diameter of 1.3mm. Red fluorescence has been noticed over a distance of 7cm in a glass container.

KEYWORDS: olive oil, Fluorescence, dye laser.

OLIVE OIL

Olive Oil is an organic complex compound made of (Fatty acids, Glycerides, Sterols, Erythrodiol, Uvaol, Wax esters, Phenolic compounds, Aroma components, Tocopherols,Hydrocarbons, Aromatic Hydrocarbons, Xenobiotics, Unsaponifiable matter, water soluble components and microscopic bits of olive) [1]. In this research when talking on using Olive Oil as a dye laser material meaning Olive Oil as a complex compound made of all the previous component not meaning one of the compounds that soluble in Olive Oil. A pure simple of Olive Oil with concentration 1 used in this research.

OLIVE OIL SPECTRUM

The calculation of dye laser beginning by the absorption and emission diagram of the material. The absorption diagram of olive oil obtained by (shimadzu UV-1601PC spectrophotometer). From absorption diagram figure 1 some absorption peaks chosen to taste the emission when excited at that peaks wavelength by (ELICO SL174 spectrofluorometer). The absorbance peak appear at selected wavelengths 414nm, 536nm, 632nm, 670nm and there emission peak when the material excited at that wavelengths shown in figures 2,3,4,5. From the emission peaks it could be seen that the maximum emission value appears when material excited at 670nm as shown in figure 5. Peak of emission to all selected absorbance wavelength being at 669nm.

CALCULATION OF SOME BASIC DYE LASER PARAMETERS OF OLIVE OIL MATERIAL

From the previous absorption, emission diagrams value of Olive Oil laser parameters could be calculated

Assume that an incident beam of high energy photons of wavelength λ_a falls on a substance for a given time interval, and during that time, lower energy (fluorescence) photons are emitted by the substance. The quantum yield $ø_f$ is then defined in [1].

The oscillator strength of the absorption bands can also be calculated easily by the free-electron model. Transition moments along and normal to the long molecular axis are connected with the oscillator strength *f* of the absorption band [1,2]

And can be calculated using the electron gas wave functions of the eigenstates between which the transition occurs. The relative strengths of the x and y component also yield the orientation of the transition moment in the molecule.

One finds good agreement on comparing the *f* values obtained from the absorption spectrum of the dye using the relation

$$f = 4.32 \times 10^{-9} \int \varepsilon(\acute{\upsilon})\, d\acute{\upsilon} \qquad \textbf{(1)}$$

Where **ε** is the numerical value of the molar decadic extinction coefficient measured in liter/(cm • mole), and ύ is the numerical value of the wave number measured in cm^{-1}[1,2].

The one process that is directly used in dye lasers is the radiative transition from the first excited singlet state S_1 to the ground state G if this emission termed fluorescence occur spontaneously its radiative lifetime t_{rf} is connected with the Einstein coefficient for spontaneous emission A and the oscillator strength *f* of the pertinent absorption band by eq.(2)

$$A \approx 1/t_{rf} = (8\pi\mu^2\, e_o^2 2\,/\,mc)\, \acute{\upsilon}^2 f \qquad \textbf{(2)}$$

Where μ is the refractive index of the solution, e_o is the charge and m is the mass of the electron, c is the velocity of light, and ύ denotes the wave number of the centre of the absorption band. The radiative lifetime t_{rf} is typically of the order of a few nanoseconds. Generally, however, the fluorescence spectrum is broad and shows considerable Stokes shift. In this case the radiative lifetime can be computed with the aid of eq.(3)

$$1/t_{rf} = 2.88 \times 10^{-9}\ \mu^2 \frac{\int F(\acute{\upsilon})d\acute{\upsilon}}{\int \acute{\upsilon}^{-3} F(\acute{\upsilon})d\acute{\upsilon}} \int \frac{\varepsilon(\acute{\upsilon})d\acute{\upsilon}}{\acute{\upsilon}} \qquad (3)$$

Where F(ύ) = dQ/dύ is the fluorescence spectrum (in quanta *Q* per wave number) and ε(ύ) is the molar decadic extinction coefficient.

The fluorescence quantum yield ϕ_f is described by the ratio of the observed fluorescence lifetime t_f and the calculated natural radiative lifetime t_{rf} a. In practice one usually knows and wants to gain knowledge about the actual fluorescence lifetime [3,4,5].

The absorption cross-section σ_a can be determined from the molar decadic extinction coefficient ε by eq.(4).

$$\sigma_{a}=0.385\text{x}10^{-20}\text{x}\varepsilon \qquad (4)$$

Where σ_a is given in cm^2, if ε is measured in liler/(mole • cm)[1].

From the physical calculation used for liquid dye laser material, it could be found that these results give as a positive indication that Olive Oil could be used as a dye laser material where the fluorescence quantum yield for the tested wavelengths ranged between (0.0248 and 0.9681) and this is a good range compared to other types of dye material, the radiative life time and fluorescence life time laying in a good range from micro seconds to mille seconds, suitable threshold pumping power and energy threshold compared to other laser types (Table1). The range of radiative life time, fluorescence life time and the normal value of threshold pumping power and energy threshold give wide range of suitable pumping sources that could be used.

EMISSION EXPERIMENT

In this experiment has been found that when a green laser radiation at wave length 532nm and power 30mw and beam diameter 1.3mm incident onto a glass container that contained Olive Oil red fluorescence noticed inside the Olive Oil and these properties could be noticed:

- The red fluorescence did not appear instantaneously but there was a delay time which was less than one second.
- 2) The intensity of the red fluorescence varies directly with the intensity of the incident laser radiation.
- The red fluorescence disappears when the intensity of the green laser radiation reduced to a 17mw, which means that this value is the threshold which is needed to induce this fluorescence.
- The red fluorescence vanishes after a distance 7cm inside the Olive Oil.

CONCLUSIONS

- A new candidate laser material has been discovered this material is Olive Oil
- Tow of Olive Oil organic compound (Linoleic , Linolenic)lye under condition that material classified according to dye materials.
- When Olive oil tested in the spectrofluorometer according to the peaks of the absorption diagram it will be obtained fluorescence peaks for each excited wavelength tested, all excited wavelength give an emission peak at wavelength 699 nm in different values.
- From the Basic Dye Laser Parameters calculations used for liquid dye laser material, it could be found that these results give a positive indication that Olive Oil could be used as a laser material compared to other types of dye materials as shown in table 1
- A quenching material need to be add to the active medium in dye laser system but its not necessary to add a quenching material to Olive Oil because it have in nature dissolved oxygen in its organics compound which could be used as a quencher to reduce triplet state effect.

Table1. Typical values of photo-physical parameters for Olive Oil and some organic compounds

	Pumping wavelength	f	$\emptyset_f$	t_{rf} ns	t_f ns	A s^{-1}	σ_a cm^2
Olive Oil	414nm	1.1×10^{-5}	0.0345	36×10^{4}	1.264×10^{4}	2.72×10^{3}	5.594×10^{-21}
	536nm	1.65×10^{-7}	0.9681	2.58×10^{7}	2.5×10^{7}	38.680	2.429×10^{-22}
	632nm	1.06×10^{-8}	0.5689	3.03×10^{8}	1.85×10^{8}	3.06	1.885×10^{-23}
	670nm	7.11×10^{-7}	0.4563	3.963×10^{6}	1.808×10^{6}	252.36	1.472×10^{-21}
	Rhodamine 6G (in water)	0.55577	0.95	100	5.4	10^{7}	0.5×10^{-16}
	Rhodamine B (Methanol)	0.310	0.62	6.1	4.23	2.36×10^{8}	2.57×10^{-16}
	Eosine	0.493089	0.67	1.3	2.58	7.61×10^{8}	-
	Flourescein, ethanol	1.35124	0.79	4.184	3.036	2.39×10^{8}	-

<u>Olive oil material can be used as a dye laser material because of :</u>

*****The condition for dye materials that its organic compound must have a two π electron bound, or two double bound called conjugated or higherso material in this condition called dye material. Olive oil contained many organic compounds. Tow of its lye under dye material condition

where these two compounds are:

a)Linoleic polyunsaturated (two double bound) (C17H29COOH) or CH3-(CH2)4-CH=CH-CH2-CH=CH-(CH2)7-COOH

b) Linolenic, which is polyunsaturated (three double bound)

So a condition to this olive oil could considered as a dye material compound.

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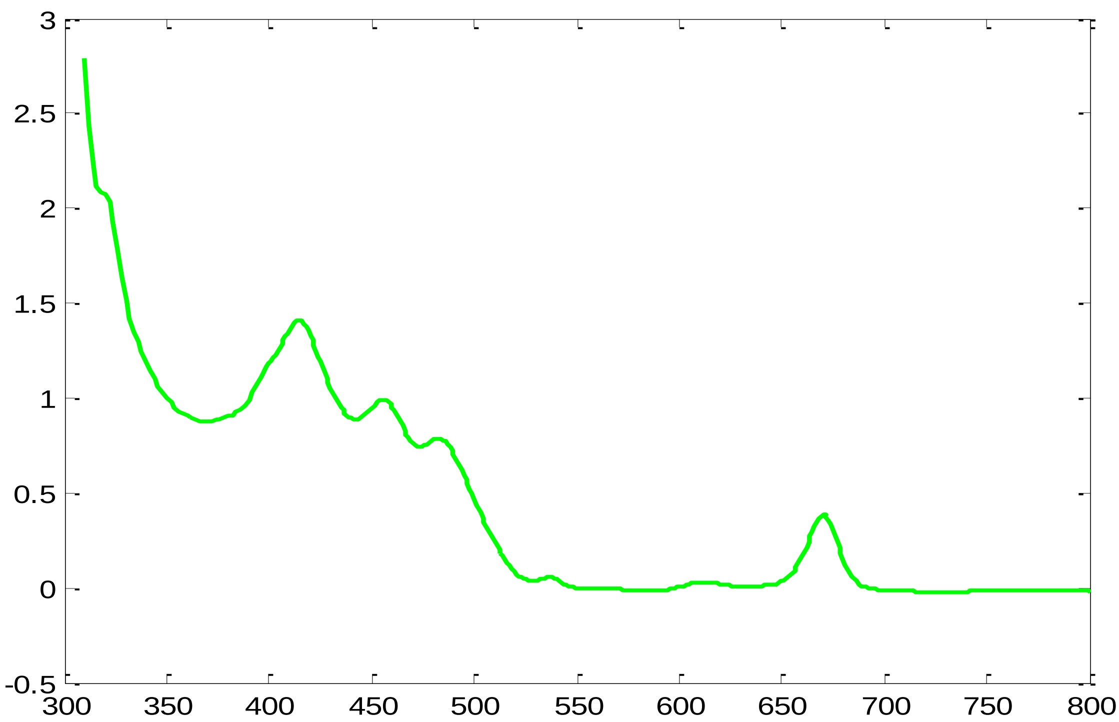

Figure (1) Absorption diagram of Olive Oil

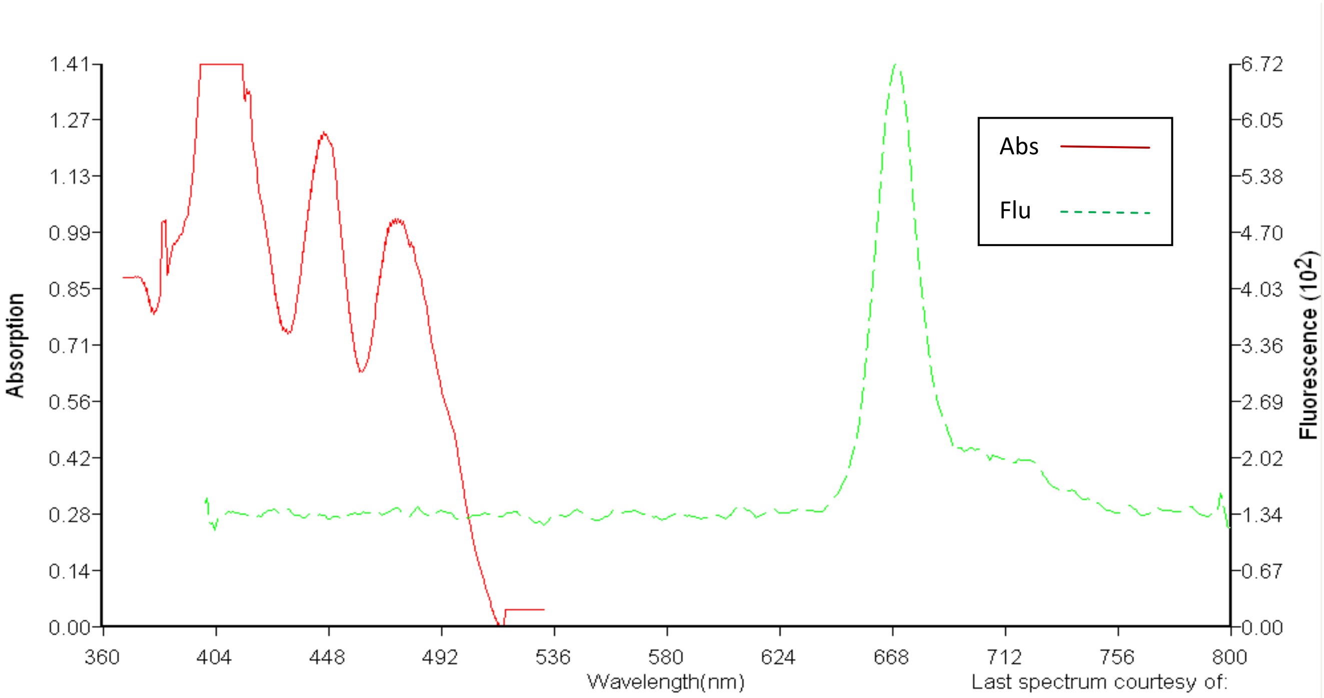

Figure (2) the absorbance peak appear at wavelength 414nm and its emission peak when the material excited at that wavelength

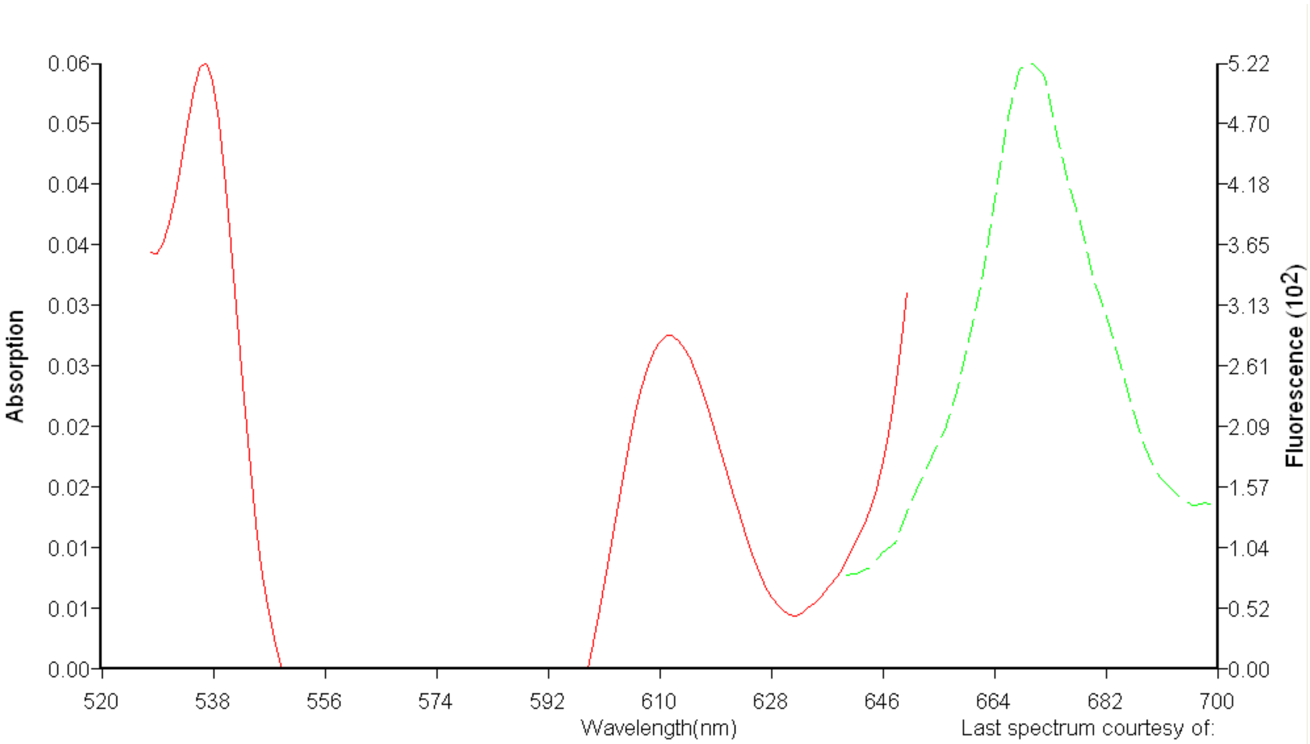

Figure (3) the absorbance peak appear at wavelength 536nm and its emission peak when the material excited at that wavelength

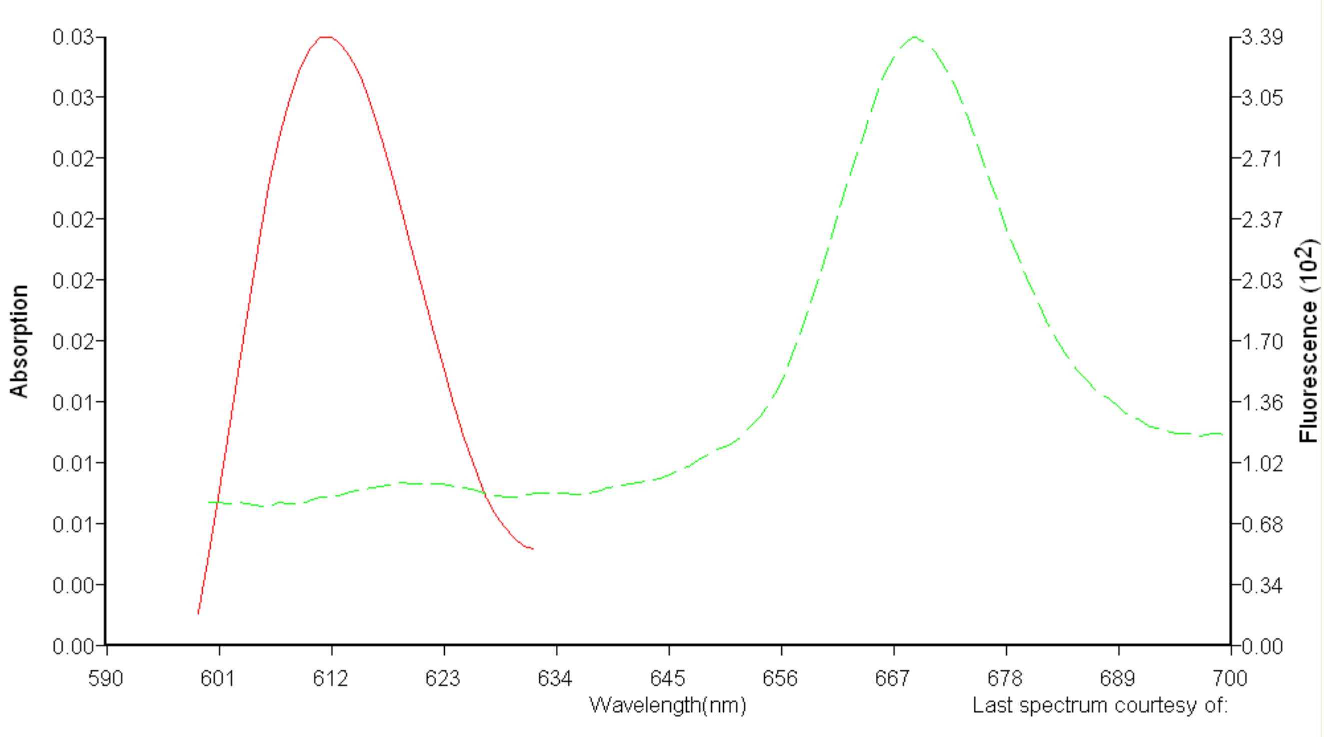

Figure (4) the absorbance peak appear at wavelength 632nm and its emission peak when the material excited at that wavelength

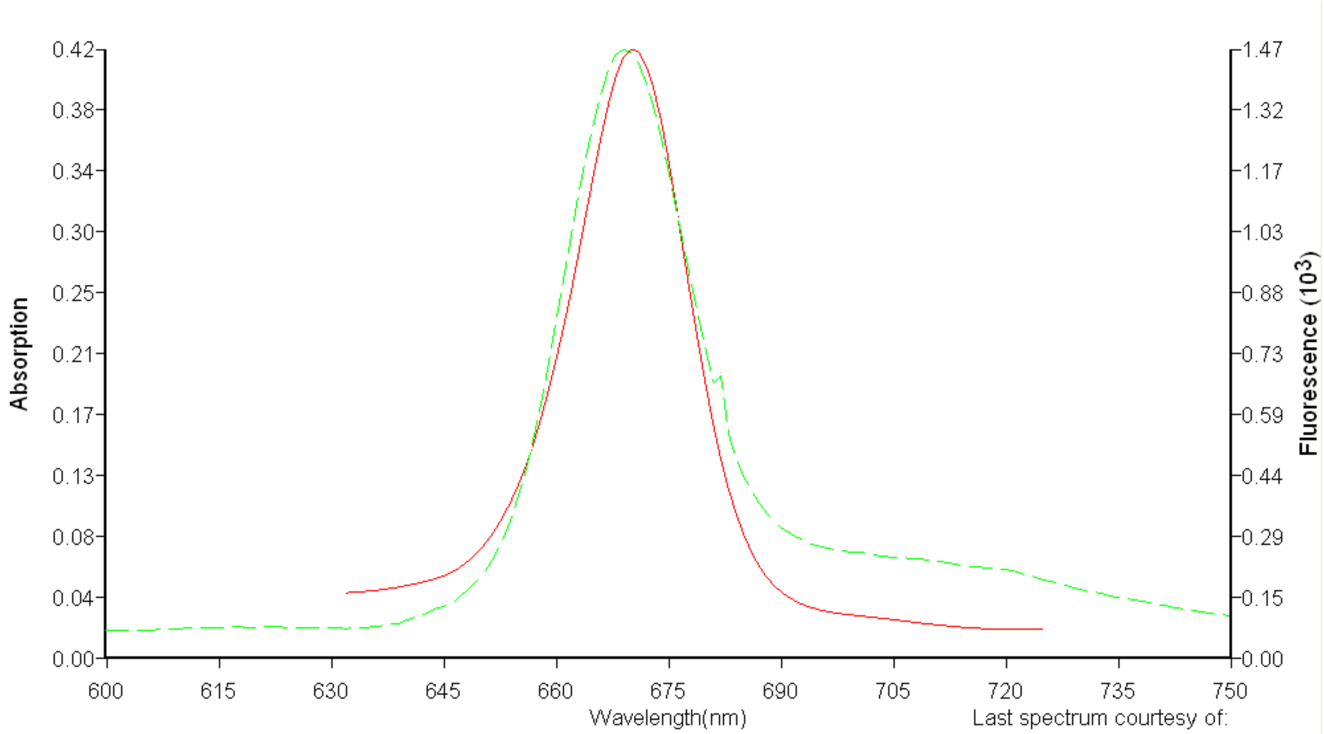

Figure (5) the absorbance peak appear at wavelength 669nm and its emission peak when the material excited at that wavelength

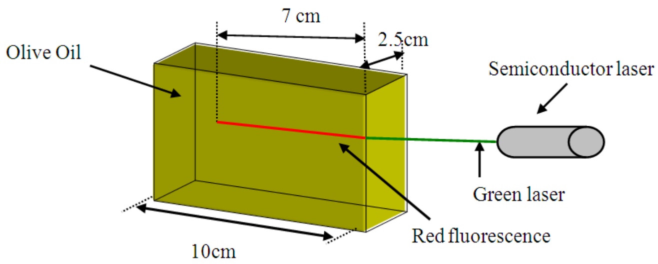

Figure (6) Olive Oil emission experiment