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Electrical, and the Performance Coefficients for the (Rhodamine B-Fluorescein) Laser Dyes Detectors

Mithaq M. Mehdy Al-Sultani, Alyaa Abd-Almehdy Al-Ramahy

Department of physics, College of Education for Girls, University of Kufa, Iraq
Corresponding Author: Alyaa Al-Ramahy, Department of physics, College of Education for Girls, University of Kufa, Iraq,
aliaa0002020@gmail.com, aliaaalramahy@yahoo.com

Abstract: *In this research, some types of laser reagents induced with laser dyes (rhodamine B and fluorescein) dissolved in ethanol and polymeric (PVP) in (0.3 g) were prepared. The absorption spectrum of the used dye fluid was studied, and some reagent parameters were prepared with different concentration (10^{-3}-10^{4}). The results of the absorption spectra showed an offset towards longer wavelengths (red shift) by increasing the molarity concentration, and the effect of the addition of the polymer material on the absorption spectra. The results also showed that the intensity and wavelength of the top of the absorption spectrum of the dyes used depend on the concentration of the dye used and the increase of the dye concentration leads to interference between the absorption spectra. Voltage - current characteristics of models prepared before laser irradiation and post irradiation were also measured. Some reagents were studied, including spectral response. The results showed that the detector has a spectral response of up to A / W (0.02) at wavelength 532 nm, while the specific detection value was (2.1×10^{9} $cmHz^{1/2}w^{-1}$).*

Keywords: Laser reagents, organic dyes, polymeric material

Introduction

Laser dyes are organic materials of somewhat complex compositions that possess a large molecular weight, because their compositions contain a series of carbon atoms linked alternately by single and double bonds. Most of the dyes have the ability to absorb visible electromagnetic rays and high efficiency [1]. The visible radiation emitted by most organic dyes has led to its use as an effective medium in dye lasers. It is the first tonable laser in the visible spectrum area, because it has a wide fluorescence spectrum that allows laser output to be toned at any value chosen within this range. Laser detectors can be defined as devices that convert incident light rays into measurable electromagnetic outputs [2]. Reagents can be divided into two types depending on the nature of the interaction between incident light rays and the reagent into thermal and photonic reagents. The difference between thermal reagents and photonic reagents is that thermal reagents respond to all falling wavelengths, whereas photonic reagents respond to a certain range of incident radiation [3]. The laser of rhodamine B dye was used in the form of solid green crystals, well soluble in ethanol, forming a red fluorinated solution when dissolved, and can be dissolved in other solvents such as distilled water and benzene. Its chemical formula is $C_{28}H_{31}N_2O_3$ Cl, and its molecular weight is 478.5 (g / mol) [4]. The fluorescein dye was also used in the form of an orange crystalline powder, forming a yellow fluorinated solution when melted, its chemical formula $C_{20}H_{12}O_5$, and its molecular weight (332.31 g / mol) [5]. Pyrrolidone Poly vinyl (PVP) with its chemical formula $(C_6\,H_9\,NO)_n$ and its molecular weight (40000 gm / mol) [6]. The solvent used for ethanol, its chemical formula ($C_2\,H_5OH$), molecular weight 46.07 (g / mol) and purity of 99.9% [7].

Materials and Methods

The dye liquid solution was prepared by dissolving an appropriate amount of dye powder in a certain volume of solvent used according to the equation below [8].

$$m = \frac{C \times V \times M}{1000} \quad \text{...} \quad (1)$$

Where
M: dye weight required to obtain the desired concentration in grams
C: The concentration to be obtained in molarity
V: solvent volume but cm^3 to be added to the material
M: molecular weight of the formula used.
Dilution was used to obtain a lighter concentration than the first concentration [8].

$$C_1V_1 = C_2V_2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

C_1: first concentration

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C_2: The second concentration
V_1: necessary size of the first concentration
V_2: The size to add to the first concentration to get the second f concentration.

Polymer material (PVP) was added (0.3) grams for the prepared concentration. The laboratory sensitive balance HR-200 was used to balance the dyes and polymer material used in the preparation of liquid samples from Japan company limited (0.0001-210 gm). The absorption spectrum emitted by the laser dye liquid solution used in the research was recorded using the SCINCO Mega-2100 UV-Visible Absorption Spectrometer with wavelengths (190-1100 nm).

The prepared models were deposited on silicon bases with dimensions of (2.5×1.5 cm^2) to obtain thin films. The bases were cleaned by mixing 10 ml distilled water and 20 ml high-purity ethanol solution by an ultrasonic cleaner that uses ultrasonic waves of 400-150 kHz. From Japan –skymen for 30 minutes to ensure good cleaning. The electrodes were then deposited from purity of 99.99% using the vacuum thermal evaporation system in the vacuum as well as the voltages and current of the prepared membranes were measured, using a digital current meter (Keithley 616-digit electrometer) to measure the change of current passing from the detector with the change of voltage. Voltage and current of the samples were measured after laser irradiation at a distance of (20) cm from the model. A laser diode of 532nm wavelength of 200mw was used. The absorption spectrum of rhodamine B and fluorescein inoculated with polymeric material (PVP) in different proportions 0.3 g was studied. The absorption spectrum was observed to increase the molarity concentration of the dye used. The highest peak absorption of the liquid rhodamine B dye solution was observed at wavelength (554 nm), for concentration of 10^{-3} M and (553 nm) for concentration 10^{-3} M. Figures (1a, b) illustrate the absorption spectrum of the liquid dye liquid (rhodamine B and fluorescein) dissolved in ethanol solution and inlaid with polymeric PVP in (0.3 g), respectively. Table (1) shows the absorption spectra properties of the laser dye (rhodamine B and fluorescein) dissolved in different concentrations of ethanol solution and inlaid with polymeric material pvp at (0.3 g). Table (2) shows the optical properties of laser dye (rhodamine B and fluorescein) dissolved in ethanol solution and inlaid with polymeric material pvp in (0.3 g).

Table (1) Absorption spectrum characteristics for laser dye in (Ethnol) solvent at four different concentrations with adding (0.3) g of (PVP) polymer

Dyes	Concentration (mol)	Peak wavelength nm	Peak	$(\Delta\nu)_{1/2} \times 10^{17}$ s^{-1}
Rhodamine B	1×10^{-3}	554	2.88	0.066
	1×10^{-4}	553	1.48	0.12
Fluorescein	1×10^{-3}	493	1.33	0.096
	1×10^{-4}	492	0.43	0.12

Table (2) Optical properties of the laser dye (rhodamine B and fluorescein) dissolved with ethanol solution and PVP polymeric material at 0.3 g

Dyes	Concentration (mol)	A	T	α m^{-1}	R	σ_{opt} (Hz)	n
(Rhodamine B)	1×10^{-3}	0.48	0.33	1105.44	0.188	1.55×10^{11}	5.8
	1×10^{-4}	0.35	0.44	806.5	0.2	8.17×10^{10}	4.2
(Florescein)	1×10^{-3}	0.22	0.602	506.66	0.17	1.27×10^{10}	2.1
	1×10^{-4}	0.05	0.891	115.15	0.058	6.91×10^{10}	3.9

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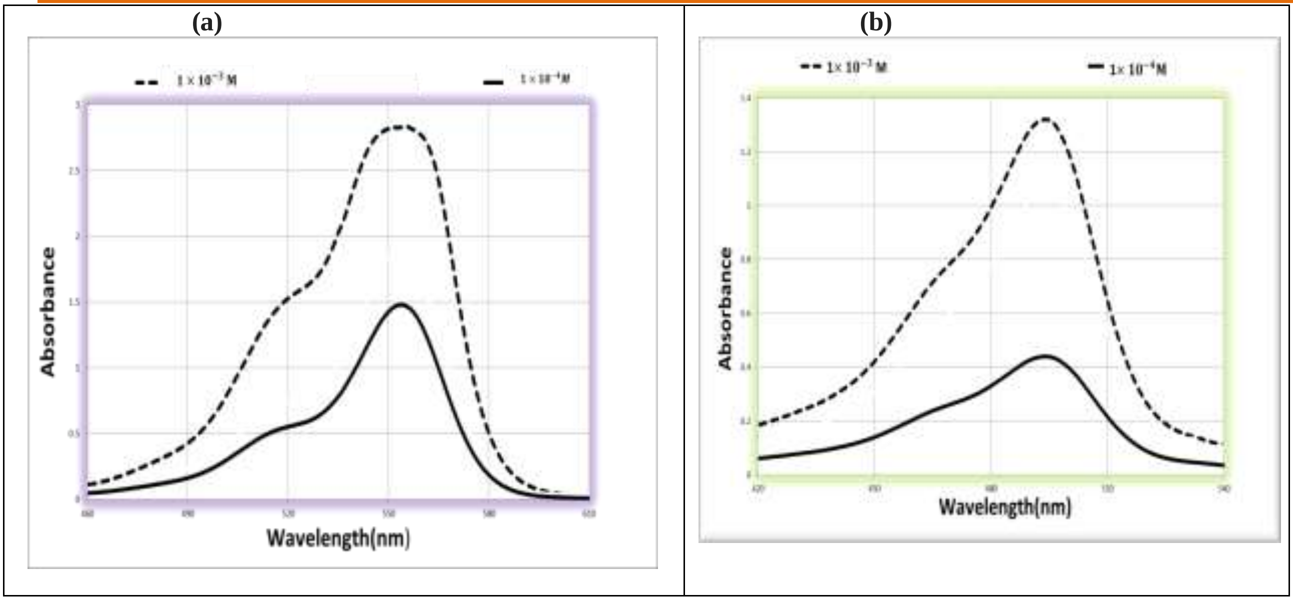

Figure (1) a. Absorption Spectra of Rhodamine B Dye Ethanol Solution Solved and polymeric of (0.3 g), b. Absorption Spectra of Fluorescein Dye Liquid Solution Dissolved Ethanol and inlaid by polymeric of 0.3 grams

Figure 2 illustrates the voltages and current of the reagents prepared. Table (3) shows the reagent coefficients for the model prepared from the dye (rhodamine and fluorescein) laser and inlaid with polymeric material by (0.3) grams at a concentration of 10^{-4} mol.

Table (3): Reagent coefficients of the model prepared from the laser dye (rhodamine and fluorescein)

Dyes	Concentration (mol)	R_λ (A/W)	NEP (W)	D (W^{-1})	D^* $cmHz^{1/2}w^{-1}$	G
(Rhodamine B-(Florescein)	10^{-4}	0.02	0.89×10^{-4}	1.1×10^{9}	2.1×10^{9}	4

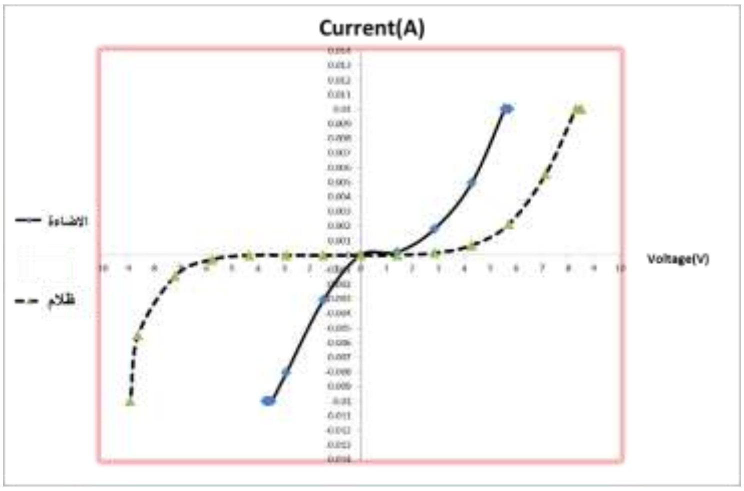

Figure (2): In the case of darkness and light (illumination using laser diode).

The absorption spectrum of rhodamine and fluorescein was studied in a different concentration of ethanol and inlaid with polymeric material by (0.3) grams. This is due to the presence of a large number of dye molecules in the ground energy level, which can absorb a sufficient number of photons. Decrease of wavelength of absorption peak with increasing molarity concentration by knowing that the large absorption by a large number of dye molecules leads to additional energy causing the wavelength of absorption peak to decrease. The use of polymeric material with laser dyes in the preparation of membranes as effective media for lasers is more important than liquid solutions. When the dye is combined with the polymeric material, it prevents the particles from spreading to the surface [9]. Prepared reagents are photonic reagents due to the increase in current by increasing the intensity of the projected light. It was found that the irradiation of the laser detector led to an improvement in the electrical properties of the detector due to the irritation of the electrons, increasing the charge carriers reaching the conduction beam as shown in Figure (2).

Conclusions

The results also showed that the equivalent power of noise varies with the current of light. This indicates that the greatest response occurs when the noise equivalent power is as low as possible. Where the qualitative reagent was calculated. The results showed that the detection increased by increasing the molarity concentration of the pigments as well as increasing the noise power. The reason for this is that detection is a function of the spectral response, so it changes with the response of the detector.

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