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RESEARCH ARTICLE

Absorption Resonance Energy Transfer between Organic Dyes (Cumarin and Rohdamain)

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Abstract

The spectral properties absorption of two laser dyes types, C480 and R610, the mixture was investigated. These types of laser dyes belong to Coumarinoids and Xanthenes family were dissolved using ethanol as solvent to prepare samples with range of ratios (1:1, 1:2, 1:3 and 1:4) from Cumarin 480 (C48) to Rohdamin 610 (R610) concentered in ($10^{-4}10^{-5},10^{-6}$) M/L at room temperature. The achieved results pointed out an increase in the absorption intensities with the increasing of the concentration of the day type R610 from 10^{-6} and 10^{-5} to 10^{-4} M/L.the same thing for C480which are absorved in agreement with Beer-Lambert law and the finished results Pointed that the absorption peak was moved toward the short wavelengths (BLUE SHIFT) when increasing the ratioconcentration.

Keywords: *Dye laser, Fluorescence resonance energy transfer, Silica gel matrices. Absorption spectrum.*

Introduction

Using types of dye laser present a noticeable improvement or reduction in the output value of the laser energy [1]. Applying two, three and four component of dye mixtures could achieve an ETDL with wide tenability. In the ETDL, Rhodamine B-DODC, crestylviolet rhodamine 6G, Coumarin-acrivlavine and different coumarin dyes with some aromatic compounds are the most common dyes applied as donor-acceptor pairs [2]. The nonradioactive process through an exciting state donor type (D), which is usually a fluorophore, transfers the energy to a proximal ground state acceptor type (A) through the interaction of the long-range dipole-dipole is called fluorescence resonance energy transfer [3, 4].

In the visible region of the electromagnetic spectrum, a strong absorption band characterize the organic dyes, this type of property can only find in the organic compounds with an extended system of conjugated bonds, alternating single and double bonds. The absorption properties of unknown dyes can be estimated using adapting the parameters of the model on the basis of empirical data [5]. The transition from the electronic ground state (S0) to the first excited single (S1) attributes by the long-wavelength of the absorption band of dyes [6]. This is related to the moment of the large transition. The spontaneous emission rate is relatively high, which is a radiative lifetime on the order of nanoseconds, meanwhile, the dye laser gains could exceed the solid-state lasers for several orders of magnitude [7]. From the radiating field, the sample can absorb the energy as photons. The absorption intensity is a verity with frequency. Where the intensity variation is defined as the absorption spectrum [8].

The spectral density is used to calculate the shape and width of the lines. The change in the quantum mechanical nature at the molecule or atom cold determine the absorption lines classification [9], also the change in the molecule vibrational state is generated the vibrational lines, for instance, the infrared region.

Whereas, the change in the molecule or atom electronic state is produced electronic lines vibration, such as visible and ultraviolet (UV) region [8],[10]. The maximum intensity of the transmission spectrum will reach at wavelengths, while more light lead to weak in the absorption and transmits through the sample. The interaction of the Donor-Acceptor could present between both solute and solvent molecules [11].

The overlap between the acceptor and donor orbitals is responsible to the additional stabilization from the charge-transfer resonance, therefore the effect of the strength and structure of the charge-transfer interactions is enhanced when this overlap is maximized due to the relative orientation of donor and acceptor molecules [12]. The active medium has emitted the energy of the laser that is equivalent to the difference between the triple-level [13]. The typical solid density is larger about 20 % than the corresponding liquid, whereas the liquid is about 800 higher than the gas dense [14].

At large temperature range, the liquid state of most compounds is surprisingly stable when the solution is the homogeneous liquid phase that produces from mixing the liquid solvent with the solute, like gas, liquid or solid [15]. The surrounding solvent molecule and solute do the mutual net attraction mutual. Where salvation is the solvent molecules aggregation around the solute [16]. The impurities influence the presence of defects through the increasing of the radiation with less rate, particularly transit IC, Internal conversion, this is between the tripartite case and the excitation singlet state case (S1) [17].

Experimental Chemical Materials

Ethanol (C_2H_5OH) with molecular weight (Mw: 46.07) get ready by Gain land Chemical Company, U.K. Ethanol is a portico solvent, polar and frequently was applied as dissolve solution for dissolve laser dyes [18].

Coumarin480

(Coumarin 480) laser dye ($C_{16}H_{17}NO_2$) used [19]. Molecular weight: (255.23) gm/M, equipped with the company Lambda physic, German.

Rhodamin610

Lambda chrome number: 6100,CAS registry number: 81-88-9R610 is a green crystalline solid [20, 21]. absorption most, in ethanol: 552 nm, Molar absorptive: 10.7L mol^{-1} cm^{-1}. Fluorescence maximum(in ethanol): 580 nm and equipped with the company (Lambda physic), German. The dye solutions are prepared with the aid of dissolving the required amount quantity of the dye into (the solvet ethanol). The dyes are prepare in concentrations (10^{-3}, 10^{-4}, $10^{-5}$and 10^{-6}) M, as shown in Figure (1). The weight of the dye is measured using a (Mattler) balance of 0.1 mg sensitivity. The wight of the dye (W) ingm.

Figure 1: concentrations (10^{-3}, 10^{-4}, 10^{-5} and 10^{-6}) M/L of C480 and R610 dyes

Dyes mixture of C480 & R610 have been prepared via fixed the ratio of C480 increased the ratio of R610 ascending. Two dyes dissolved in Chloroform to prepare to prepare ($1*10^{-4}$, $1*10^{-5}$ and $1*10^{-6}$) M/L At room temperature dissolved in ethanol to get ready (1:1, 1:2, 1:3 and 1:4 ratio) from (C48): (R610) in (10^{-4}, 10^{-5} and 10^{-6}) M/L concentration. The same think for (R610: C480) the sample was prepared at At room temperature, as shown in Figure (2),(3).

Figure 2: (1:1, 1:2, 1:3, 1;4, ratio) from(C48) : (R610) in (10^{-4},10^{-5},10^{-6}) M/L concentrations

Figure 3: (1:1, 1:2, 1:3 and 1:4) ratio from (R610) :(C48) : in(10^{-4},10^{-5},10^{-6}) M/L concentration

Results and Discussion

The absorbance spectrum of the Dyes solution(C480) and R610 in ethanol C_2H_5OH is measured at room temperature for the dyes solution dssolved in ethanol are (1 □10 □4,1□10 □5,1□10 □6) M/L concentrations as shown in Figure .4.

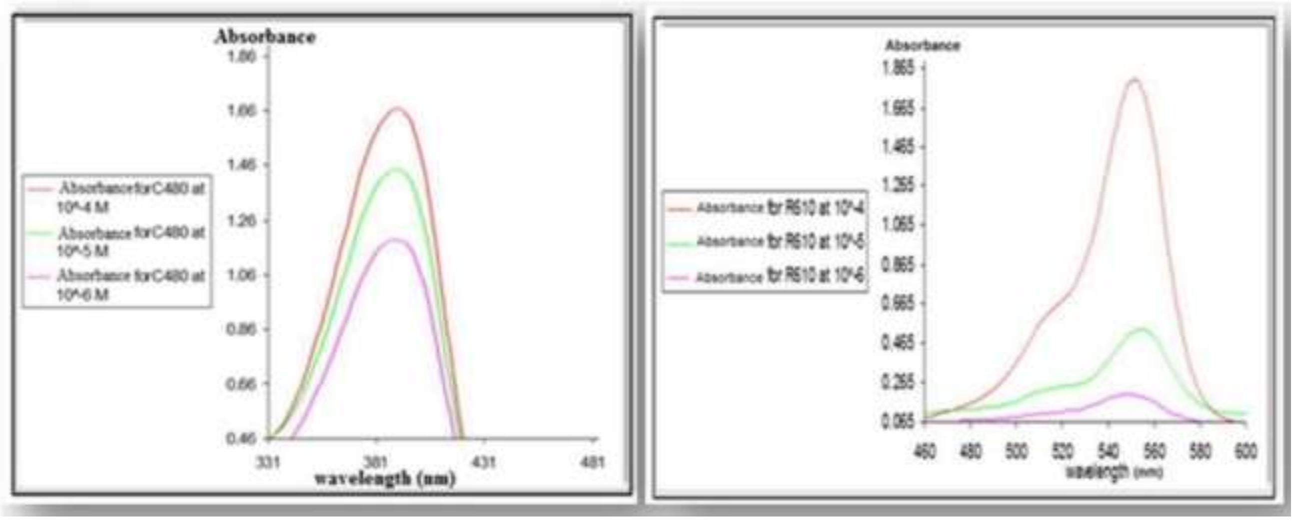

Figure 4: The Absorbance Spectrum for C480 and R610 dissolvent in ethanol

Table 1: The effect of concentration on the absorbance spectrum of the dyes C480 and R610 in dissolvent in ethanol

C480		
concentration	Wavelength(nm)	Absorbance
1X 10^-4	391	1.668
1X 10^-5	388	1.432
1X 10^-6	386	1.179

R610		
concentration	Wavelength(nm)	Absorbance
1X 10^-4	553.8	1.81
1X 10^-5	551	0.537
1X 10^-6	584.2	0.070

Figure (4) illustrated The absorbance spectra of dye solution C480 and R610 dissolved in the ethanol asolvent at room temperature and at concentrated ($1*10^{-4}$, $1*10^{-5}$ and $1*10^{-6}$) M/L . The results from table (1)show greater bsorbance (1.668) nm at the maximum wavelength (391) nm when the concentration ($1*10^{-4}$) M/Land observes that the decrease in concentration leads to move the peak of the absorbance spectrum towards the shorter wavelength (Blue Shift) to became (388) nm and absorbance (1.432) when the concentration decrease to the ($1*10^{-5}$) M/L. The results show lower absorbance (1.179) at the minimum wavelength (386) nm when the concentration decrease to the ($1*10^{-6}$) M/L for C480 dye. Where the R610 dye show greater absorbance (1.81) at the maximum wavelength (553.8) nm when the concentration ($1*10^{-4}$) M/L, and observes that the decrease in concentration leads to move the peak of the absorbance spectrum towards the shorter wavelength (Blue Shift) to became (551) nm and absorbance (0.537) when the concentration decrease to the ($1*10^{-5}$) M/L. The results show lower absorbance (0.206) at the minimum wavelength (550) nm when the concentration ($1*10^{-6}$) M/L.The absorbance spectrum of the dyes solution C480 and R610 in ethanol solvent, (C_2H_5OH) according to the ratio of C480 and R610 (1:1, 1:2, 1:3 and 1:4) respectively, the absorbance spectrum is measured at room temperature for the dye solution at ($1*10^{-4}$, 1×10^{-5} and $1*10^{-6}$) M/L as shown in Figure (5) and (6).

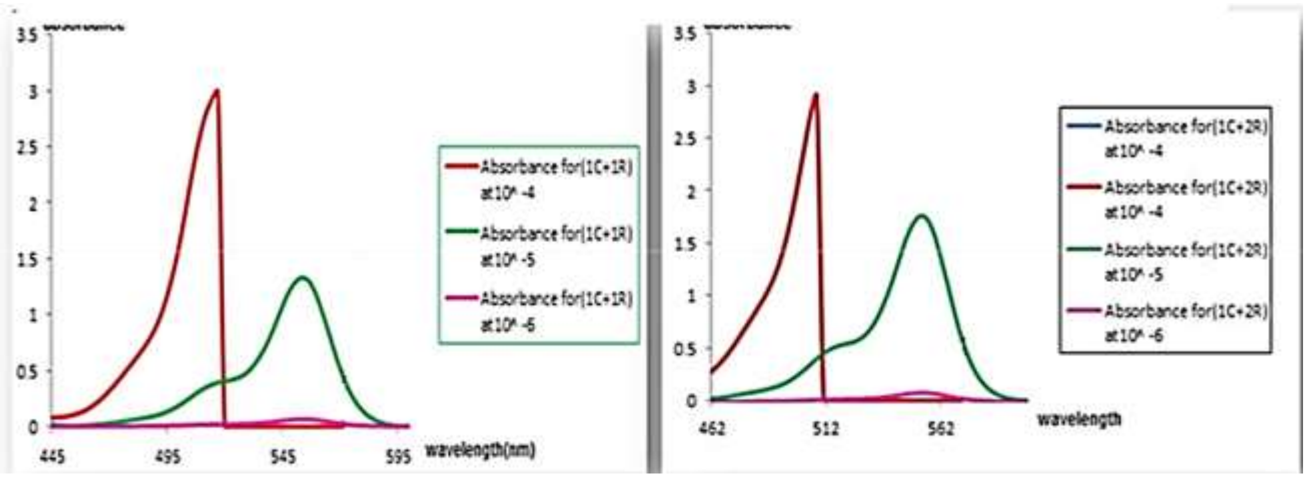

Figure 5: The Absorbance Spectrum for (1C480 +1R610) and (1C480 +2R610) Dissolved in ethanol at (1×10^{-4}, 1×10^{-5} and 1×10^{-6}) M /L concentrations

Table 2: The effect of concentration on the absorbance spectrum of the ratio from Dye (1C480:1R610) and (1 C480:2R610) ratio in ethanol solvent

1C480:1R610		
concentration	Wavelength(nm)	Absorbance
1X 10^-4	517	2.9866
1X 10^-5	550	1.277
1X 10^-6	547	0.05

1C480:2R610		
concentration	Wavelength(nm)	Absorbance
1X 10^-4	508	2.8923
1X 10^-5	553	1.7561
1X 10^-6	553	0.07133

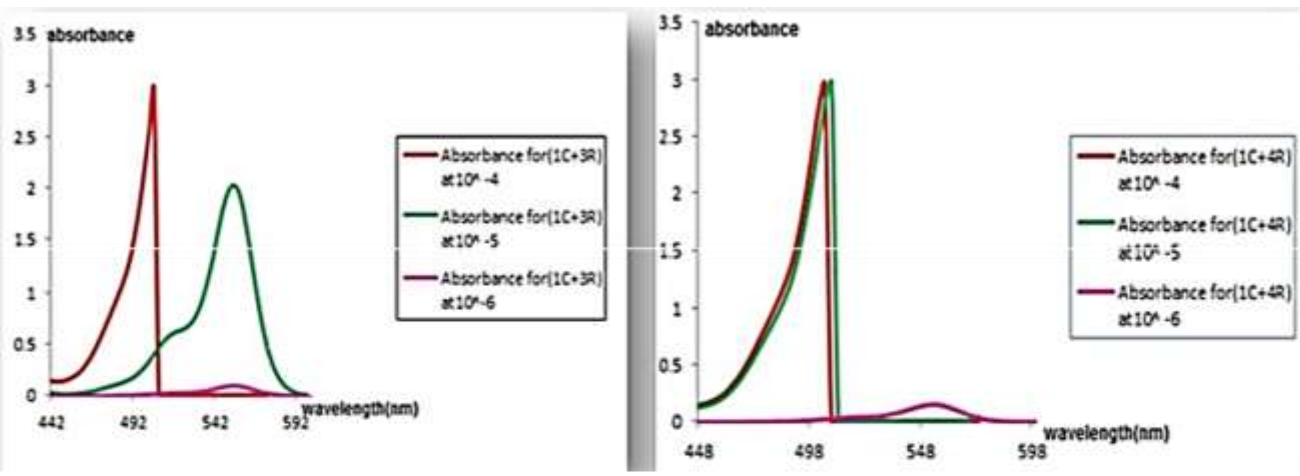

Figure 6: The absorbance spectrum of (1C480 +3R610) and (1C480 +4R610) dissolved in ethanol at ($1*10^{-4}$, $1*10^{-5}$ and $1*10^{-6}$) M/L concentrations

Table 3: The effect of concentration on the absorbance spectrum of the ratio from dye (1480:3R610) and (1 C480:4R610) ratio in ethanol solvent

1C480:3R610			1C480:4 R610		
concentration	Wavelength(nm)	Absorbance	concentration	Wavelength(nm)	Absorbance
1X 10^-4	505	2.9488	1X 10^-4	508	2.9610
1X 10^-5	550	1.9464	1X 10^-5	505	2.942
1X 10^-6	550	0.0854	1X 10^-6	544	0.1084

Figure (5) and (6)illustrate the absorbance spectra of the dye solution C480 and R610 dissolved in ethanol solvent at room temperature and at concentrations ($1*10^{-4}$, $1□10^{-5}$ and $1*10^{-6}$) M/L according to the ratio of C480 and R610 (1:1, 1:2, 1:3 and1:4). The results from table (2 and 3) show greater absorbance was (2.9866) at a ratio (1C480:1R610) at the wavelength (517) nm at the concentration ($1*10^{-4}$) M/L and observes that the increase in ratio of R610 leads to move the peak of the absorbance spectrum towards the longer wavelength (Red Shift) to became (544) nm at lower absorbance (0.1084) when the ratio (1C480:4R610), at the concentration decrease to the ($1*10^{-6}$) M/L. The absorbance spectrum of the dyes solution R610 and C480 in ethanol solvent (C_2H_5OH) according to the ratio of R610 and C480 (1:1, 1:2, 1:3 and 1:4).The absorbance spectrum is measured at room temperature for the dye solution at ($1*10^{-4}$, $1□10^{-5}$ and $1*10^{-6}$) M/L concentrations,as shown In Figure (7) and (8).

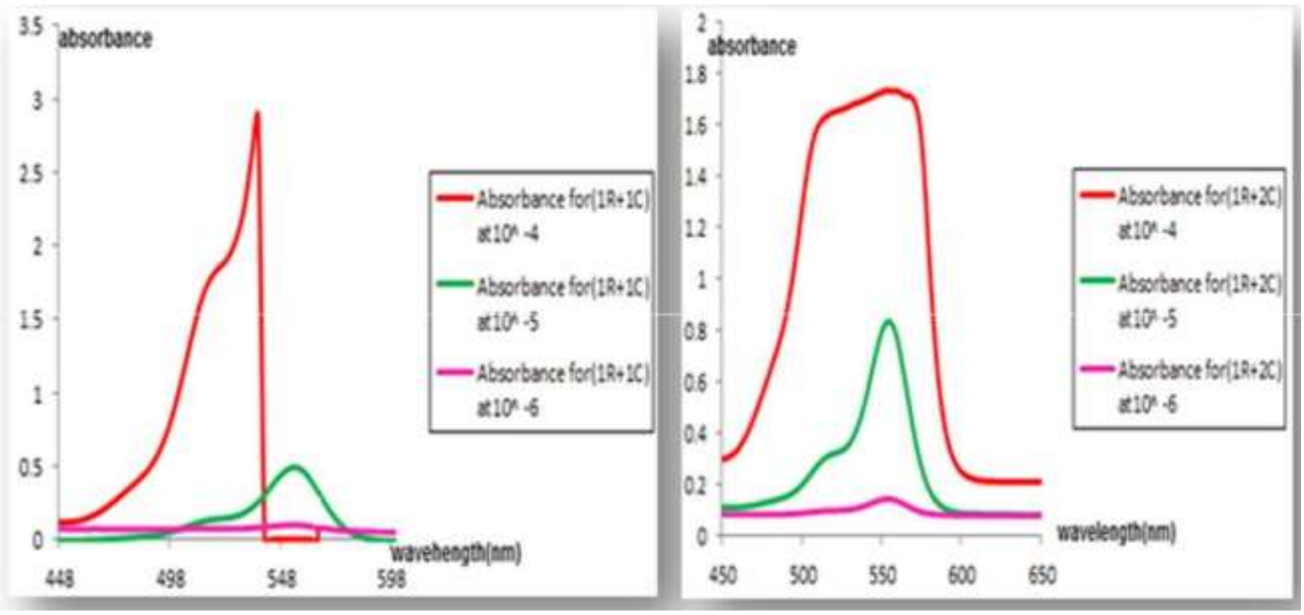

Figure 7: The Absorbance Spectrum for (1R610+1C480) and (1R610+2C480) Dissolved in ethanol at ($1□10^{-4}$, $1□10^{-5}$ and $1□10^{-6}$) ML concentrations

Table 4: The effect of concentration on the absorbance spectrum of the ratio of the dye (1R610:1C480) and (1R610:2C480) ratio in ethanol solvent

1R610:1C480			1R610:2C480		
concentration	Wavelength(nm)	Absorbance	concentration	Wavelength(nm)	Absorbance
1X 10^-4	532	1.6810	1X 10^-4	528	2.871
1X 10^-5	550	0.7931	1X 10^-5	547	0.419
1X 10^-6	526	0.10	1X 10^-6	520	0.0730

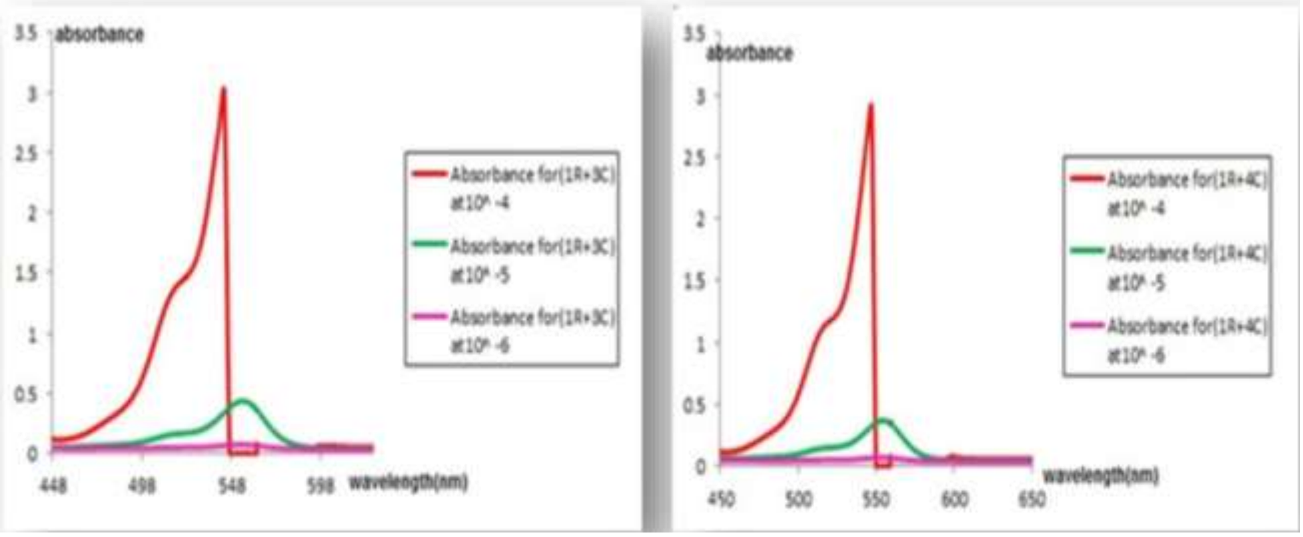

Figure 8: The absorbance spectrum for (1R610+3C480) and (1R610+4C480) dissolved in ethanol at ($1\square10^{\square4}$, $1\square10^{\square5}$ and $1*10^{\square6}$) M/L concentrations

Table 5: The effect of concentration on the absorbance spectrum of the ratio of dye (1R610:3C480) and (1R610:4C480) ratio in Ethanol Solvent

1R610:3C480			1R 610:4C480		
concentration	Wavelength(nm)	Absorbance	concentration	Wavelength(nm)	Absorbance
1X 10^-4	388	2.126	1X 10^-4	547	2.892
1X 10^-5	367	0.2088	1X 10^-5	550	0.324
1X 10^-6	349	0.070	1X 10^-6	550	0.0648

Figure (7) and (8) illustrated the absorbance spectra of dye solution R610 and C480 dissolved in ethanol solvent at room temperature and at concentrations ($1*10^{\square4}$, $1\square10^{\square5}$ and $1*10^{\square6}$) M/L according to the ratio of R610 and C480 (1:1, 1:2, 1:3 and 1:4). The results from table (4 and 5) showed greater absorbance was (2.892) at a ratio (1R610:4C480) at the wavelength (547) nm at the concentration ($1*10^{\square4}$) M/L, and increased the ratio of C480 leads to move the peak of the absorbance spectrum towards the longer wavelength (red Shift) to became (550) nm at lower absorbance (0.0648) when the ratio (1R610:4C480) at the concentration decrease to the ($1*10^{\square6}$) M/L.

Conclusions

From upper result not that the make mixed between two dyes was effected on the spectroscopy properties and this effect depend on the ratio of mixed. Increases absorption intensity due to increasing stability, as a result of the arrangement of atoms in more regular. it was noted that the spectra of obsorption.

Finally, it was conclude that process of mixing dyes had an obvious effect on the spectra of absorbance where they recorded the highest peaks of the absorbance intensity. The ratios of a mixture between the dyes (R610 & C480) were equal, this was because of the mutual effect between the two dyes, and the effect resulted from the spectral resonance overlap between spectral absorbance region for C480 dye and R610 spectral absorbance region.

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