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ORIGINAL PAPER

Chemiluminescence Characteristics of Furan Derivatives as Blue Fluorescers in Peroxyoxalate-Hydrogen Peroxide System

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Abstract Furan derivatives (synthesized and purified in organic laboratories) are a great interest as fluorescent emitters for peroxyoxalate chemiluminescence. Reaction of peroxyoxalates such as bis-(2,4,6-trichloro-phenyl) oxalate with H_2O_2 can transfer energy to fluorophore via formation of dioxetanedione intermediate. Furan derivatives used as a novel fluorescer in this study which produces a blue light in the chemiluminescence systems. The relationship between the chemiluminescence intensity and concentrations of TCPO, sodium salicylate, hydrogen peroxide and the fluorescer has been investigated. The linear ranges for Furan derivatives were $0.25–5\times10^{-4}$ M and $0.1–5\times10^{-4}$ M (A and B compounds, respectively). Kinetic parameters for the peroxyoxalate-chemiluminescence were also calculated from the computer fitting of the corresponding chemiluminescence intensity/time profiles.

Keywords Peroxyoxalate chemiluminescence · Fluorescer · TCPO · Hydrogen peroxide · Furan derivative

Introduction

The peroxyoxalate-hydrogen peroxide system is the only chemiluminescent reaction supposed to involve an intermolecular chemically initiated electron exchange luminescence (CIEEL) [1], Mechanism with proven high quantum yields [2]. This system consists of a base-catalyzed reaction of activated oxalic phenylesters with hydrogen peroxide in the presence of highly fluorescent aromatic hydrocarbons with low oxidation potentials as chemiluminescent activators. Mechanistic studies using various oxalic esters and a variety of experimental conditions led to the determination of rate constants for several reaction steps as well as the proposal of different high-energy intermediate structures [3–5]. The increasing interest in the peroxyoxalate-chemiluminescence (PO-CL) system is due to its high ability for the detection of quenchers and analytical applicability as a sensitive tool for studying and quantifying numerous analytes [6–12].

The development of reactions to produce heterocyclic compounds is of vital importance in organic synthesis, especially the heterocycles which can be found in naturally occurring products. A number of heterocyclic compounds such as furan, and pyran rings are found in natural systems. Furan rings, one example of five-membered heterocycles, are found in many naturally occurring products [13]. The furan ring is not only present as key structural unit in naturally occurring products, but it is also important in the pharmaceutical chemistry [14, 15].

In this paper, we report the study of chemiluminescence from the reaction of bis-(2, 4, 6-trichlorophenyl) oxalate (TCPO) and hydrogen peroxide with three furan derivatives as an efficient fluorescence brightener, in the presence of sodium salicylate as a base catalyst. Three Furan derivatives of Dimethyl 2-[(2,6-dimethylphenyl) amino]-5-[(*E*)-2-phenyl-1-ethenyl]–3,4-furan dicarboxylate (A), Dimethyl 2-[(t-buthyl)amino]-5-[(*E*)-2-phenyl-1-ethenyl]-3,4-furan dicarboxylate (B) and Dimethyl 2-[(2,6-dimethylphenyl)amino]-5-[(*E*)-1-methyl-2-phenyl vinyl]-3,4-furan dicarboxylate (C) were used (Fig. 1). Tow Furan derivatives (A and B) are found intense

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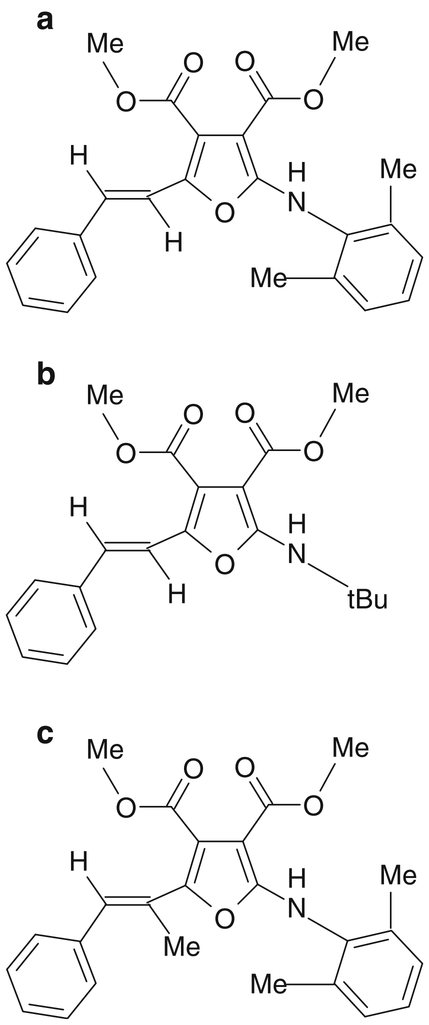


Fig. 1 Molecular structure of **a** Dimethyl 2-[(2,6-dimethylphenyl) amino]-5-[(*E*)- 2-phenyl-1-ethenyl]-3,4-furan dicarboxylate **b** Dimethyl 2-[t-buthyl amino]-5-[(*E*) 2-phenyl-1-ethenyl]-3,4-furan dicarboxylate **c** Dimethyl 2-[(2,6-dimethylphenyl)amino]-5-[(*E*)-1-methyl-2-phenyl vinyl]-3,4-furan dicarboxylate

and useful fluoropher compounds containing aromatic functional group with low energy π→π* transition level (blue light emission). Particularly, compounds A and B are suitable for chemiluminesce proses as a fluorophore. But, exist one CH_3 group in a molecule C causes a quenching in chemiluminescence system. Kinetic parameters for the peroxyoxalate-chemiluminescence of Tow Furan derivatives were calculated from the computer fitting of the corresponding chemiluminescence intensity-time plots.

Experimental

Reagents

TCPO was prepared from the reaction of 2,4,6-trichlorophenol with oxalylchloride in the presence of triethylamine as described elsewhere [16]. Hydrogen peroxide (Merck; Perhydrol Suprapur, 30 % in water) was assayed by permanganate potassium titration [17]. The fluorescer was synthesized and purified in organic laboratories. We described in detail the preparation of polyfunctionalized furan ring by reaction of alkyl isocyanides with dialkyl acetylenedicarboxylate in the presence of trans-cinnamaldehyde. The yield of reaction for production of the furan derivative was about 65 % [18]. The mechanism of preparation of furans derivatives showed Scheme 1.

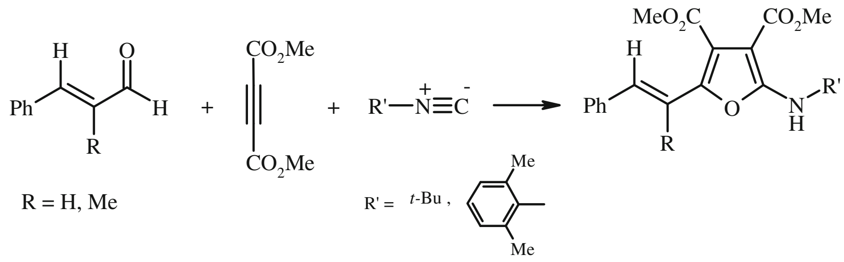
Chemiluminescence Measurements

Chemiluminescence detection was performed with a home-made apparatus equipped with a model BPY47 photocell (Leybold, Huerth, Germany). The apparatus was connected to a personal computer via a suitable interface (Micropars, Tehran, Iran) as shown in Fig. 2 [19]. Experiments were carried out with magnetic stirring (500 rpm) in a light-tight flattened bottom glass cell of 15 mm diameter at room temperature. The fluorescence spectra were recorded on a Model LS-3B Perkin-Elmer instrument.

Procedures

Solution I was made with mixing 2 ml of TCPO (0.044 M) and 0.05 ml of fluorescer (various concentrations in ethyl acetate). Solution II contained 2 ml of 1.62 M hydrogen peroxide and the 1 ml of sodium salicylate (0.04 M) in methanol. Solution I was transferred into the instrument quartz cuvette via polypropene syringes. Then 200 μl of solution II was injected into the quartz cuvette and the chemiluminescence spectrum was recorded after mixing of the reagents in the cell.

Scheme 1 The mechanism of preparation of furans derivatives



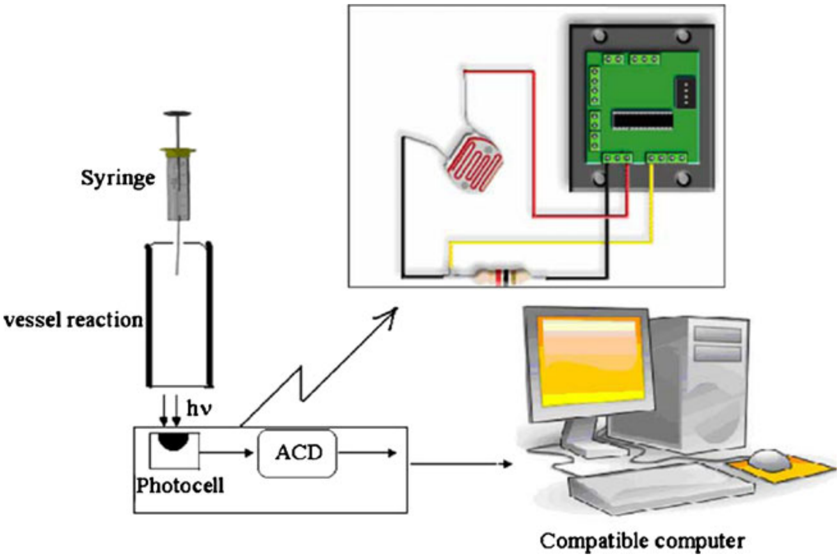
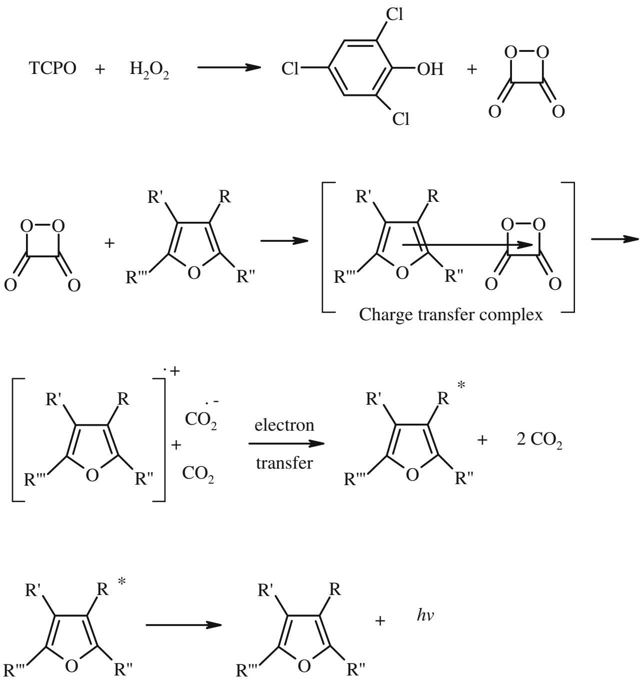


Fig. 2 Shematic representation of batch system for measuring visible chemiluminescence

Results and Discussion

The possible mechanisms of the PO-CL reaction with considering what reported in the literature are imaged in Scheme 2 [7, 20, 21]. The intensity, duration and color of emission of the PO-CL systems are of great importance [7].

In the first step, an aryl oxalate ester like TCPO reacts with H_2O_2 to produce a key chemical intermediate of 1,2- dioxetandione (C_2O_4) as an excitation source. The second step, excited cyclic C_2O_4 intermediate transfers its energy to fluorophore (here Furan derivatives were used as fluorophore).



Scheme 2 The mechanism of PO-CL reaction

The final step is the emission of light energy by returning the excited fluorophore molecule to the ground state. The florescence spectra of compounds A and B are shown in Fig. 3. The fluorescence and chemiluminscence of the compound A is higher than that of B, at the same conditions. The phenyl moiety on the nitrogen atom of A can increase the resonance forms of it not only by additional six π electrons in the benzene ring but also by the electron with drawing properties of the ring. Overlap of p orbital with the π bond results in the longer conjugated system in A. With increasing of π conjugation, the energy difference between HOMO and LUMO decrease, and led to the feasibility of absorption and fluorescence of A.

The displacement of hydrogen atom B with methyl group in C led to the increasing steric hinderance near the furan moiety. Flattering of a molecule has an important rule in the conjugation of the delocalized π electrons especially in the aromatic molecules. The methyl group can distort the bond between double bond and the furan nucleous in the C derivative. The plain contain phenyl and double bond with methyl group in C must be rotate and therefor decrease the π conjugation in C.

Decreasing of π conjugation in C can cause to decrease of resonance forms and lower fluorescence intensity of it. Figures 4 and 5 show chemiluminescence intensity as a function of time (intensity/time emission profile) for the PO-CL system in the presence of varying concentrations of furan derivatives A and B, respectively. Plot of chemiluminescence intensity as a function of fluorophore concentration (compounds A and B) is inserted on top of right hand side of Figs. 4 and 5 respectively. However, the plot of reciprocals of CL intensity against furan derivatives resulted in a linear calibration graph (Fig. 6), the linear ranges for compound A and B predicted $0.25–5\times10^{-4}$ M and $0.1–5\times10^{-4}$ M, respectively [6].

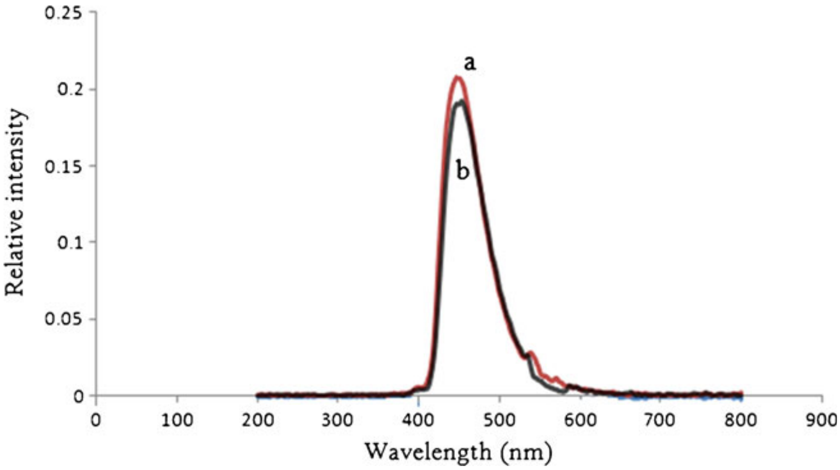


Fig. 3 The fluorescence emission spectra of Dimethyl 2-[(2,6-dimethylphenyl)amino]-5-[(*E*)- 2-phenyl-1-ethenyl]-3,4-furan dicarboxylate (**a**) and Dimethyl 2-[t-buthyl amino]-5-[(*E*) 2-phenyl-1-ethenyl]-3,4-furan dicarboxylate (**b**) at same concentration of 5.0×10^{-5} M with λ_{ex}=330 nm

Plot of chemiluminescence intensity as a function of fluorophore concentration (compounds A and B) is inserted on top of right hand side of Figs. 4 and 5 respectively. Correlation between the CL intensity and the TCPO concentration for both fluorophore is listed in Tables 1 and 2. The influence of H_2O_2 concentration on the PO-CL for both compounds A and B was studied at constant concentrations of other reagents and presented in Tables 1and 2.

Figure 7a and b show the influence of H_2O_2 concentration on the PO-CL of fluorescer, there is a direct linear relationship between the concentration of hydrogen peroxide and CL intensity of the system. It is noteworthy that further increase in H_2O_2 concentration was found to have no measurable effect on the PO-CL intensity [7].

The observed behavior is clearly indicative of the catalytic effect of sodium salicylate on the PO-CL system studied [3]. In order to investigate the optimal concentration of sodium salicylate, the CL response of the H_2O_2, TCPO, fluorescers system were measured against the varying concentrations of the base and the resulting plot is shown in Fig. 8. The PO-CL intensity increased with increasing concentration of sodium salicylate until a concentration of 1.0×10^{-3} M is reached, the observed intensity enhancement being indicative of the catalytic effect of the sodium salicylate. However, further addition of sodium salicylate revealed a gradual decrease in the CL intensity. This is most probably due to a quenching effect of the base at higher concentrations, which begins to decompose the reactive intermediate, dioxetane dione, and hence reduces the PO-CL light [22].

The results show that the concentration of TCPO and fluorescer have a more significant influence on the chemiluminescence system, than the concentrations of H_2O_2 and sodium salicylate i.e., on the rise (k_r) and fall (k_f) rates constants. In the former case, by increasing concentration

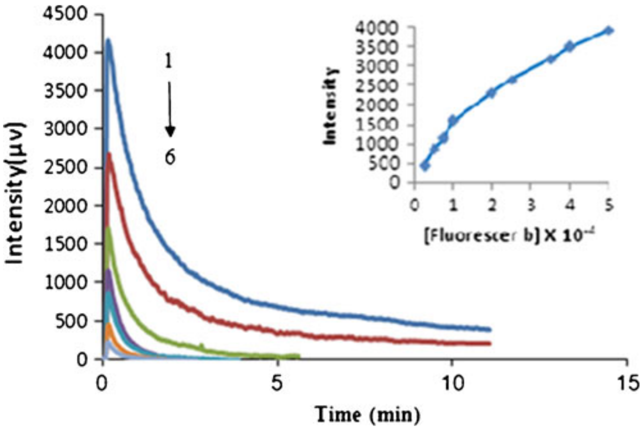


Fig. 4 Chemiluminescence emission intensity as a function of time for the TCPO-H_2O_2-furan derivatives (and sodium salicylate) system with constant concentration of TCPO (3.2×10^{-2}), H_2O_2 (8.0×10^{-2}), sodium salicylate (1.0×10^{-3}), and varying concentrations of Dimethyl 2-[(2,6-dimethylphenyl)amino]-5-[(*E*)- 2-phenyl-1-ethenyl]-3,4-furan dicarboxylate: (1) 5×10^{-4} (2) 2.5×10^{-4} (3) 1.0×10^{-4} (4) 7.5×10^{-5} (5) 5×10^{-5} (6) 2.5×10^{-5}

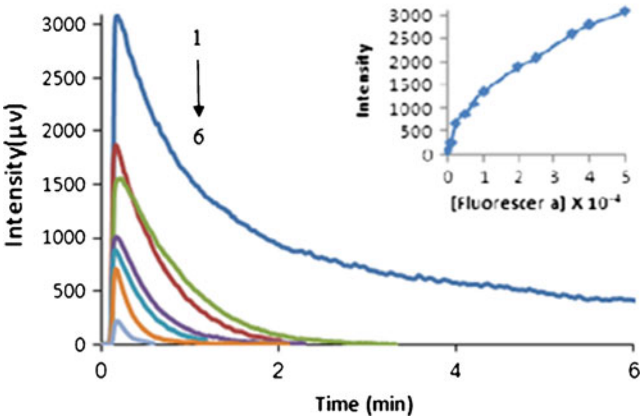


Fig. 5 Chemiluminescence emission intensity as a function of time for the TCPO-H_2O_2-furan derivatives (and sodium salicylate) system with constant concentration of TCPO (3.2×10^{-2}), H_2O_2(8.0×10^{-2}), sodium salicylate (1.0×10^{-3}), and varying concentrations of of Dimethyl 2-[t-buthyl amino]-5-[(*E*) 2-phenyl-1-ethenyl]-3,4-furan dicarboxylate: (1) 5×10^{-4} (2) 2.5×10^{-4} (3) 1.0×10^{-4} (4) 7.5×10^{-5} (5) 5×10^{-5} (6) 2.5×10^{-5}

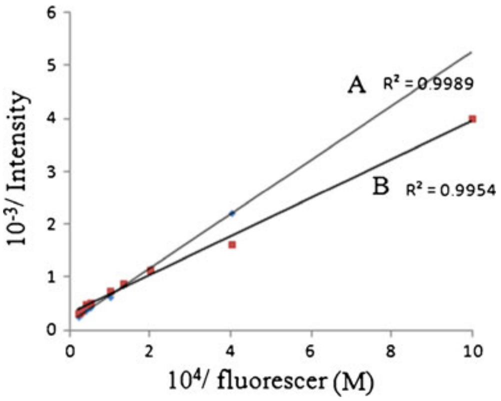


Fig. 6 Effect of furan derivatives concentration on the CL intensity of **a** TCPO-H_2O_2-/Dimethyl 2-[(2,6-dimethylphenyl)amino]-5-[(*E*)- 2-phenyl-1-ethenyl]-3,4-furan dicarboxylate- Sodium salisylate and **b** TCPO -H_2O_2 -/Dimethyl 2-[t-buthyl amino]-5-[(*E*) 2-phenyl-1-ethenyl]-3,4-furan dicarboxylate- Sodium salisylate system

of TCPO, the values of fall rates constant (k_f) become larger, on the other hand, enhancing concentration of fluorescer caused to decrease of k_f .

In order to evaluate the kinetic data for the PO-CL system studied from the resulting CL intensity–time plots, a pooled intermediate model was used [23, 24]. According to this model, the CL reaction is simplified as:

$$A \xrightarrow{k_r} B \xrightarrow{K_f} C \qquad (1)$$

where A, B and C represent pools of reactants, intermediates and products, respectively, and both reaction steps designated by the rate constants k_r and k_f are irreversible first order reactions. The integrated rate equation for the CL intensity versus time is:

$$I_t = \left[\frac{M}{k_f - k_r}\right]\left[\exp(-k_r t) - \exp\left(-k_f t\right)\right] \qquad (2)$$

where I_t is the CL intensity at time t, M is a theoretical maximum level of intensity if the reactants were entirely converted to a CL-generating material, k_r and k_f are, respectively, the first order rate constants for the rise and fall of the burst of CL. A further advantage of this model is that it not only allows the determination of parameters M, k_r and k_f, but also it permits an estimate of the intensity at maximum level

Table 1 CL parameters calculated from computer fitting of the CL intensity-time plots for TCPO-H2O2- Dimethyl 2-[(2,6-dimethylphenyl) amino]-5-[(*E*)-1-methyl-2-phenylvinyl]-3,4-furan dicarboxylate sodium salicylate system

Parameter changed	Concentration (M)	K_r (min^{-1})	K_f (min^{-1})	M	J	T_{ex} (min)	τ_{max}(min)	Y	I
H_2O_2	8×10^{-2}	4.40±0.20	0.48±1.83	2683.10±11.23	2340	0.33	0.46	3104.16	2490
	6×10^{-2}	4.05±0.23	0.27±1.35	2149.16±39.59	2015	0.27	0.42	2872.33	2230
	4×10^{-2}	4.35±0.19	0.39±1.54	1915.00±7.56	1520	0.43	0.46	2242.41	1760
	2×10^{-2}	3.92±0.15	0.41±1.48	730.69±13.09	560	0.35	0.48	1358.11	625
	1×10^{-2}	3.82±0.14	0.62±1.88	307.56±5.86	216	0.45	0.52	491.35	244
TCPO	3.2×10^{-2}	5.64±0.28	0.64±0.02	3072.73±74.36	2321	0.43	0.37	3752.40	2960
	1.6×10^{-2}	5.07±0.23	0.47±1.74	2014.78±39.08	1780	0.31	0.51	2285.95	1990
	0.8×10^{-2}	4.41±0.16	0.34±1.18	1098.66±16.85	880	0.46	0.52	1194.14	1230
	0.4×10^{-2}	5.38±0.21	0.37±1.26	886.78±13.93	820	0.35	0.45	943.60	780
	0.2×10^{-2}	4.36±0.14	0.24±0.02	530.02±74.36	446	0.41	0.49	730.39	466
Sodium salycilate	1.2×10^{-3}	4.23±0.25	0.62±0.76	3045.72±52.86	2354	0.42	0.48	3269.13	2460
	1.0×10^{-3}	4.80±0.27	0.76±3.32	2141.10±90.44	1896	0.29	0.34	2800.00	2120
	8.0×10^{-4}	4.73±0.24	0.58±2.31	2310.27±55.13	2020	0.28	0.32	2650.00	2450
	6.0×10^{-4}	4.65±0.22	0.38±1.69	1892.83±39.60	1710	0.27	0.47	2010.00	1940
	4.0×10^{-4}	4.57±0.21	0.40±1.60	816.24±16.02	676	0.32	0.52	820.00	790
Dimethyl 2-[(2,6-dimethyl phenyl)amino]-5-[(*E*)-1-methyl-2-phenylvinyl]-3,4-	2.0×10^{-4}	3.72±0.20	1.12±4.69	489.37±15.90	312	0.29	0.35	340.00	360
	5.0×10^{-4}	4.56±0.21	0.70±0.25	3210.01±620	3123	0.32	0.47	2931.32	3084
	2.5×10^{-4}	4.51±0.20	0.85±0.21	2843.01±78.60	2620	0.28	0.37	2351.12	1998
	1.0×10^{-4}	4.01±0.41	1.21±0.11	1718.66±84.30	1312	0.29	0.41	1731.15	1550
	7.5×10^{-5}	3.84±0.21	1.84±0.31	1584.27±43.20	993	0.28	0.32	1547.14	1008
	5.0×10^{-5}	2.45±0.18	2.45±0.32	1224.35±242.90	724	0.28	0.37	915.56	884
	2.5×10^{-5}	2.30±0.36	2.30±0.36	891.55±77.70	523	0.24	0.23	406.97	695

Statistical parameters $R=0.964$ $F=266.390$ correlation is significant at the 0.01 level

Table 2 CL parameters calculated from computer fitting of the CL intensity-time plots for TCPO-H_2O_2- Diethyl 2-[(t-buthyl amino)]-5-[(*E*)-1-methyl-2-phenylvinyl]-3,4-furan dicarboxylate sodium salicylate system

Parameter changed	Concentration (M)	K_r (min^{-1})	K_f (min^{-1})	M	J	T_{ex} (min)	τ_{max} (min)	Y	I
H_2O_2	8×10^{-2}	4.119±0.19	0.55±1.93	2554.22±78.39	1976	0.44	0.56	3326.33	3050
	6×10^{-2}	4.08±0.17	0.38±1.36	1976.67±35.11	1572	0.34	0.43	2387.71	2330
	4×10^{-2}	4.298±0.19	0.39±1.60	1395.28±12.87	912	0.33	0.42	1802.72	1510
	2×10^{-2}	3.79±0.15	0.46±1.61	1024.21±19.41	711	0.36	0.48	1049.28	750
	1×10^{-2}	4.28±0.16	0.29±1.13	704.89±56.57	294	0.36	0.45	846.62	315
TCPO	3.2×10^{-2}	5.69±0.31	0.67±0.83	3072.73±74.36	2218	0.28	0.33	3012.00	3390
	1.6×10^{-2}	5.07±0.23	0.47±1.741	2014.78±39.08	1780	0.31	0.34	1957.00	2150
	0.8×10^{-2}	4.15±0.18	0.34±1.37	1598.66±16.85	1075	0.44	0.54	1689.00	1172
	0.4×10^{-2}	3.22±0.30	0.28±0.31	886.78±13.93	670	0.29	0.30	943.00	759
	0.2×10^{-2}	3.97±0.31	0.24±0.02	530.02±74.36	359	0.23	0.24	478.00	450
Sodium salycilate	1.2×10^{-3}	4.01±0.19	0.56±0.76	3045.72±52.86	2354	0.42	0.48	3269.13	2460
	1.0×10^{-3}	4.83±0.24	0.49±2.02	3111.47±71.94	2660	0.40	0.50	3386.96	3230
	8.0×10^{-4}	4.06±0.19	0.52±2.65	2525.25±63.92	1990	0.37	0.49	2697.82	2180
	6.0×10^{-4}	4.02±0.19	0.68±2.28	1804.11±42.34	1340	0.33	0.47	1996.53	1590
	4.0×10^{-4}	3.98±0.21	1.69±3.41	1230.23±35.32	990	0.30	0.42	1746.23	1160
Diethyl 2-[t-buthyl amino]-5-[(*E*)-1-methyl-2-phenylvinyl]-3,4 -furan dicarboxylate	2.0×10^{-4}	2.63±0.27	2.63±0.27	959.81±79.00	663	0.34	0.37	978.64	670
	5.0×10^{-4}	4.49±0.22	0.62±0.25	3355.01±62.00	3298	0.32	0.43	4159.35	3950
	2.5×10^{-4}	4.42±0.23	0.701±0.21	2724.70±72.60	2230	0.27	0.36	3285.16	2664
	1.0×10^{-4}	4.30±0.31	1.33±1.02	1783.60±83.20	1355	0.27	0.34	1338.91	1997
	7.5×10^{-5}	3.24±0.26	3.24±0.26	1582.49±153.00	993	0.27	0.30	979.33	1158
	5.0×10^{-5}	3.15±0.28	3.15±0.28	926.95±126.00	863	0.27	0.31	532.60	860
	2.5×10^{-5}	2.95±0.28	2.95±0.23	755.95±224.00	502	0.26	0.33	475.20	452

Statistical parameters R=0.965 F=272.059 correlation is significant at the 0.01 level

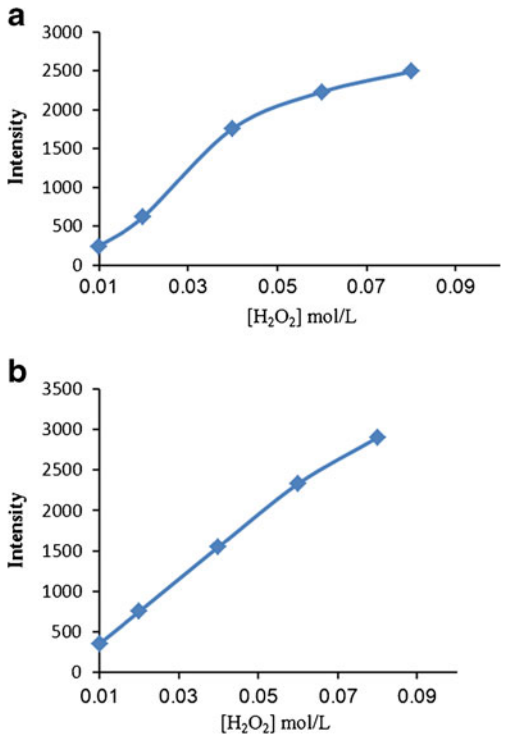


Fig. 7 Dependence of the H_2O_2 concentration **a** on the CL intensity of TCPO-H_2O_2- Dimethyl 2-[(2,6-dimethylphenyl)amino]-5-[(*E*)- 2-phenyl-1-ethenyl]-3,4-furan dicarboxylate -Sodium salisylate system, **b** on the CL intensity of TCPO-H_2O_2-Dimethyl 2-[t-buthyl amino]-5-[(*E*) 2-phenyl-1-ethenyl]-3,4-furan dicarboxylate -Sodium salisylate system

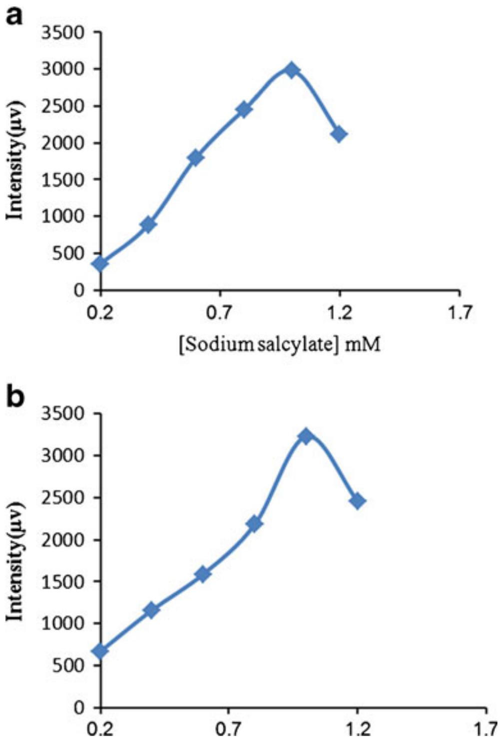


Fig. 8 Dependence of the Sodium salicylate concentration **a** on the CL intensity of TCPO-H_2O_2 Dimethyl 2-[(2,6-dimethylphenyl)amino]-5-[(*E*)-2-phenyl-1-ethenyl]-3,4-furan dicarboxylate -Sodium salicylate system, **b** on the CL intensity of TCPO-H_2O_2- Dimethyl 2-[t-buthyl amino]-5-[(*E*) 2-phenyl-1-ethenyl]-3,4-furan dicarboxylate -Sodium salicylate system

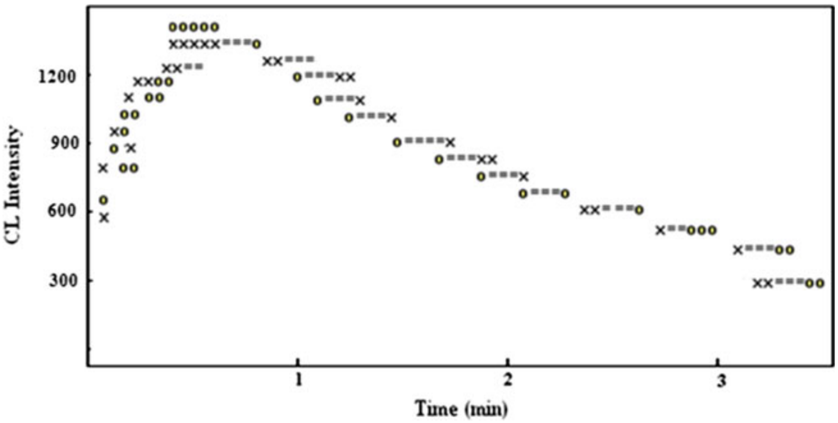


Fig. 9 A typical computer fitting of the CL intensity-time plot TCPO-H_2O_2- Dimethyl 2-[(2,6-dimethylphenyl)amino]-5-[(*E*)- 2-phenyl-1-ethenyl]-3,4-furan dicarboxylate -Sodium salicylate system. [H_2O_2]= 0.08 M, [Sodium salicylate]=1.0×10^{-3} M, Dimethyl 2-[(2,6-dimethylphenyl)amino]-5-[(*E*)- 2-phenyl-1-ethenyl]-3,4-furan dicarboxylate=5×10^{-4} M and [TCPO]=3.2×10^{-2} M: (X) experimental point; (o) calculated point; (=) experimental and calculated points are the same within the resolution of the plot

(*J*), the time of maximum intensity ($\tau_{\max}$) and the total light yield (*Y*), as follows:

$$J = M\left(\frac{k_f}{k_r}\right)^{\left[k_f/\left(k_f-k_r\right)\right]} \tag{3}$$

$$\tau_{\max} = \frac{\ln\left(k_f/k_r\right)}{k_f - k_r} \tag{4}$$

$$Y = \int_0^\infty I_t dt = \frac{M}{k_f} \tag{5}$$

In this work, a non-linear least-squares curve fitting program KINFIT [25] was used to evaluate the *M*, k_r and k_f values from the corresponding CL intensity–time plots. A typical computer fit of the CL intensity time plots is shown in Figs. 9 and 10. The other parameters *J*, $\tau_{\max}$ and *Y* were then evaluated from Eqs. (3) to (5) using the k_r, k_f and *M* values. The kinetic parameters thus obtained for all experiments carried out are summarized in Tables 1 and 2.

The statistical results (R^2 and F) obtained by application of SPSS indicate that, there is a satisfactory agreement between the calculated (J) and experimental ($I_{\max}$) values of the intensity at the maximum CL (Tables 1 and 2).

Conclusion

The present study describes a chemiluminesecence system of H_2O_2- bis-(2,4,6-trichlorophenyl) oxalate (TCPO) using furan derivatives as fluorescer. In this system, the blue

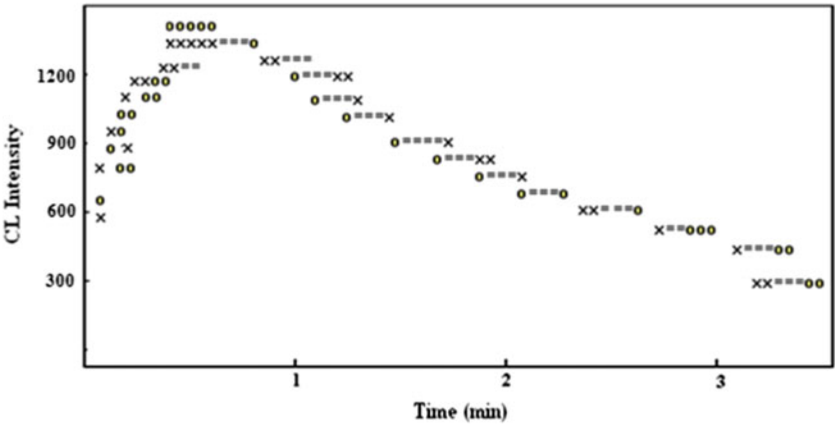


Fig. 10 A typical computer fitting of the CL intensity-time plot TCPO-H_2O_2- Dimethyl 2-[t-buthyl amino]-5-[(*E*) 2-phenyl-1-ethenyl]-3,4-furan dicarboxylate -Sodium salicylate system. ([H_2O_2]=0.08 M, [Sodium salicylate]=1.0×10^{-3} M, Dimethyl 2-[t-buthyl amino]-5-[(*E*) 2-phenyl-1-ethenyl]-3,4-furan dicarboxylate= 5×10^{-4} M and [TCPO]=3.2×10^{-2} M: (X) experimental point; (o) calculated point; (=) experimental and calculated points are the same within the resolution of the plot

fluorescence and chemiluminscence light of compound A is higher than that of B, at the same conditions. Also, the results indicated that how concentrations of the components involved in CL influence on the light emission. Kinetic parameters for the peroxyoxalate-chemiluminescence of fluorescer were calculated from the corresponding chemiluminescence intensity-time plots. A non-linear least-squares curve fitting program KINFIT was used to evaluate the theoretical maximum level of intensity (M), the first order rate constants for the rise k_r and fall k_f of the burst of CL. The furan studied derivatives were found to be an intense and useful fluorescer compounds that produces blue light emission. The mechanism of PO-CL reaction pooled intermediate model and kinetic parameters effect of CL components concentration on hight intensity.

References

1. Schuster GB (1979) Chemiluminescence of organic peroxides. Conversion of ground-state reactants to excited-state products by the chemically initiated electron-exchange luminescence mechanism. Acc Chem Res 12(10):366–373
2. Silva SM, Casallanovo F, Oyamaguchi K, Ciscato LFLM, Stevani CV, Baader W (2002) Kinetic studies on the peroxyoxalate chemiluminescence reaction: determination of the cyclization rate constant. Luminescence 17(5):313–320
3. Catheral CLR, Palmer RBJ (1984) Chemiluminescence from reactions of bis(pentachlorophenyl)oxalate, hydrogen peroxide and fluorescent compounds. Kinetics and mechanism. J Chem Soc Faraday Trans 2 80(7):823–836
4. Orosz G, Givens RS, Schowen RL (1996) Model for mechanism of peroxyoxalate chemiluminescence as applied to detection in liquid chromatography. Crit Rev Anal Chem 26(1):1–27
5. Kwakman PJM, Brinkman UAT (1992) Peroxyoxalate chemiluminescence detection in liquid chromatography. Anal Chim Acta 266 (2):175–192
6. Sigvardson KW, Kennish JM, Birks JW (1984) Peroxyoxalatec hemiluminescence detection of polycyclic aromatic amines in liquid chromatography. Anal Chem 56(7):1096–1102
7. Mohan AG (1985) Chemi and Bioluminescence. Burr JG, Dekker M, New York, p 245
8. Robards K, Worsfold PJ (1992) Analytical applications of liquid-phase chemiluminescence. Anal Chim Acta 266(2):147–173
9. Hadd AG, Birks JW (1995) Chemical analysis. Selective detectors. Wiley, New York, p 209
10. Shamsipur M, Chaichi MJ (2001) Quenching effect of triethylamine on peroxyoxalate chemiluminescence in the presence of 7-amino-4-trifluoromethylcumarin. Spectrochim Acta A 57:2355–2358
11. Shamsipur M, Chaichi MJ (2003) Quenching effect of DL(±)α-methylbenzylamine on peroxyoxalate chemiluminescence of 7-amino-4-trifluoromethylcumarin. J Photochem Photobiol A 155 (1–3):69–72
12. Shamsipur M, Chaichi MJ (2005) A study of quenching effect of sulfur-containing amino acids l-cysteine and l-methionine on peroxyoxalate chemiluminescence of 7-amino-4-trifluoromethylcumarin. Spectrochim Acta A 61:1227–1231
13. Lipshutz BH (1986) Five-membered heteroaromatic rings as intermediates in organic synthesis. Chem Rev 86:795–819
14. Nakanishi K, Goto T, Ito S, Natori S, Nozoe S (1975) Natural products chemistry, vol 6. Kodansha Ltd. and Academic Press, Tokyo-New York pp 205–212
15. Yavari I, Nasiri F, Moradi L, Djahaniani H (2004) A simple approach to the systems of dialkyl 5-tert-butylamino-[2,2′] bifuranyl-3,4-dicarboxylate. Tetrahedron Lett 45:7099–7101
16. Mohan AG, Turro NJ (1974) A facile and effective chemiluminescence demonstration. J Chem Educ 51:528–529
17. Skoog DA, West DM (1992) Holler FJ Fundamentals of analytical chemistry, 6th edn. Saunders HBJ, Orlando, p 860
18. Asghari S, Qandalee M (2007) Facile one-pot synthesis of amino furans using trans-cinnamaldehyde in the presence of nucleophilic isocyanides. Acta Chim Slov 54:638–641
19. Samadi-Maybodi A, Akhoondi R, Chaich MJ (2010) Studies of new peroxyoxalate-H2O2 chemiluminescence system using quinoxaline derivatives as green fluorophores. J Fluoresc 20:671–679
20. Campbell AK (1988) Chemiluminescence. VCH, New York, pp 510–515
21. Givens RS, Schowen RL (1989) Chemiluminescence and Photochemical Reaction Detection in Chromatography. VCH, NewYork, Chapter 5, pp 125–147
22. Shamsipur M, Chaichi MJ (2003) Quenching effect of dl(±)-methylbenzylamine on peroxyoxalate chemiluminescence of 7-amino-4-trifluoromethylcumarin. J Photochem Photobiol A Chem 155:69–72
23. Orlovic M, Schowen RL, Givens RS, Alvarez F, Matuszewski B, Parekh N (1989) A simplified model for the dynamics of chemiluminescence in the oxalate-hydrogen peroxide system: toward a reaction mechanism. J Org Chem 54(15):3606–3610
24. Hadd AG, Seeber A, Birks JW (2000) Kinetics of two pathways in peroxyoxalate chemiluminescence. J Org Chem 65(9):2675–2683
25. Dye JL, Nicely VA (1971) A general purpose curve fitting program for class and research use. J Chem Educ 48:443–448