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Effect of Temperature on Chemiluminescence of Luminol in Aqueous Ethyl Amines with H_2o_2+ Metal Ions

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***Abstract**: Effect of temperature on the chemiluminescence (CL) of Luminol aqueous ethyl amine(DEA) in binary mixture of oxidant such as H_2O_2+ Fe(III), H_2O_2+ Cu(II), H_2O_2+ Ni(II), H_2O_2+ Co(II) have been studied and reported. On the basis of experimental results, it is found that the chemiluminescence intensity initially increased with temperature, attains an optimum value of particular temperature and then decrease on further increase in temperature. It is also found that maximum CL intensity (I max) of chemiluminescence of Luminol aqueous ethyl amine founds with Hydrogen peroxide + Co(II).*

***Keywords:** Chemiluminescence, Luminol, Amine, Temperature, Metal Ions.*

I. Introduction

An enormous interest in the studies on the effect of temperature on luminescence properties have been emerged in past fewyears as it provides important informationconcerning the nature of luminescent material.Several reviews have been published relating toapplications of chemiluminescence in analysis[1-3]. It is also proved to be useful for analyticalapplications and increasing investigationsresulted in highly sensitive and selectivedetection methods[4-7]. In case of manysubstances which are not luminescent at roomtemperature shows luminescence at highertemperature[8]. Ettingeret. al[9] have observedpronounced effect on light yield with change insolvent temperature. Recently Kheret. al[10]reported the effect of temperature on thechemiluminescence of alcohols and aldehydes.Obviously the dependence of luminescenceintensity on temperature is extremely interestingfrom experimental and theoretical point of viewas it helps in understanding the basicmechanism of Chemiluminescence (CL)excitation in chemical components. The CL ofLuminol has been studied either in aqueousalkaline solution of sodium hydroxide[11] orcarbonates[12]. Very little work onchemiluminescence of Luminol in aqueousaliphatic amines at different temperatures havebeen reported. The pH dependence of luminol[11]showed maximum CL intensity at pH 12. It isobserved that aqueous solution of aliphaticamines has pH of 10 to 12. The present paperreports the studies on the effect of temperatureon the chemiluminescence of Luminol-aqueous ethyl amine in presence of binary mixture of oxidant (Hydrogen peroxide + metal ions) and the result have been discussed on the basis of present theories.

II. Experimental

All the chemicals used in the present investigation were taken in solution and prepared by using AR grade material adopting standard method. Solutions of all chemical compound was prepared in double distill water. Commercially available Luminol was used without further purification. The alkaline solution of Luminol was prepared by adding aqueous solution of ethyl amines. It is observed that aqueous solution of ethyl amine amines has pH of 10.82. All solutions used were freshly prepared. Luminol in aqueous alkaline medium showed a self-glow. Therefore, it is necessary to prepare these solutions whenever required. Solutions of known concentrations of ethyl amines is prepared in double distill water. An exact concentration of Luminol is prepared by dissolving a known weight of the substance in one litre of aqueous amine solution. Binary mixtures of oxidants such as H_2O_2+ Fe(III), H_2O_2+ Cu(II), H_2O_2+ Ni(II), H_2O_2+ Co(II)is used to study their effects on CL of Luminol at different temperatures.

All the experiments were performed on a chemiluminometer setup which essentially consists of chemiluminescent cell, high voltage supply and light detector with a recorder. The chemiluminescence cell is a double walled cubical box and inner part of the cell is cylindrical. A heater coil is wounded round the cylinder, which may be connected to a variac. Two circular holes were made in the top surface of the box. One for placing syringe to inject H_2O_2 solution in the cuvate and other for placing thermocouple in the CL cell. The cuvate is fitted inside the top surface of the light tight box and it rests just below the circular hole in which the syringe is placed. The cuvate was highly transparent glass tube of 1.0 cm diameter and 5 cm length. The box was covered with black cloths and syringe was placed on the hole. The light emitted during the reaction was detected by photomultiplier tube. All the measurement was carried out in dark. As mentioned earlier the CL cell has the heating arrangement in it. The heater was connected to the varica. The temperature of the cell was varied by changing voltage by the variac. The temperature of the CL cell was measured by inserting a thermocouple in the cell through the hole made at the top surface of the light tight box. To avoid the heating of the

photomultiplier tube, a thick rubber sheet with a hole at its center was placed between the CL cell and PMT housing.

III. Results And Discussion

The optimum CL intensity at different temperatures of chemiluminescence of Luminol ethyl amine(EA) in presence of binary mixture of oxidant such as H_2O_2+ Fe(III), H_2O_2+ Cu(II), H_2O_2+ Ni(II), H_2O_2+ Co(II) have been summarized in Table 1.

Table 1. Optimum of CL Intensity of Luminol Diethyl amine at different temperatures in presence of binary mixture of oxidant.

Sr. No	Temperature (^{0}C)	Optimum CL intensity I max (Arb. Unit)at different temperatures in Binary mixture of oxidant			
		H_2O_2+Fe(III)	H_2O_2+Cu(II)	H_2O_2+Ni(II)	H_2O_2+Co(II)
1	30	48.2	41.9	52.5	57.2
2	40	60.4	55.2	63.8	68.1
3	50	88.2	76.6	84.2	89.4
4	60	104.4	119.2	126.5	157.8
5	70	44.6	42.4	49.1	52.5
6	80	38.1	35.8	42.6	46.2

The time dependence of CL intensities of chemiluminescence of Luminolethyl amine at 60^{0}Ctemperatures in presence of H_2O_2+Fe(III), H_2O_2+ Cu(II), H_2O_2+Ni(II) and H_2O_2+Co(II) are as shown in Graph 1. It was observed that there is only one peak in the CL intensity versus time curve and the shape of the glow curve is almost same at all the temperatures. It is further observed that CL intensity initially increases with increase in time, attains an optimum value and then with further increase in time it decreases. From Fig. 2, we found that the peak CL intensity of chemiluminescence of Luminol-DEA in presence of binary mixture of oxidants attains an optimum value at 60^{0}C, then decreases with further increase in temperature and finally disappears. It is also observed that the time corresponding to attain the optimum CL peak decreases with increase in temperature.

IV. Conclusion

In the present investigation we have found that the CL intensity initially increases with increase in temperature attains an optimum value then decreases with further increase in temperature. Rate of reaction increases with increase in temperature and probability of radiative process may decrease with further increase in temperature. Thus we expect that the CL intensity should be optimum at a particular temperature. From this study on effect of temperature on the chemiluminescence of Luminol ethyl amines shows CL and CL intensity initially increases with increase in temperature attains an optimum value then decreases with further increase in temperature. It is also conclude that the CL intensity of CL of Luminolethyl amine shows highest optimum CL intensity at 600C when binary mixture of oxidant is selected. The highest CL intensity is found with hydrogen peroxide + Co(II) than the H_2O_2+Fe(III), H_2O_2+Cu(II), and H_2O_2+Ni(II) as shown in fig.2. It is also clear that the metal ions acts as a catalyst during the chemiluminescence of luminol ethyl amine.

Fig. 1: Time dependent of CL Intensity of Luminol Aqueous Ethyl amine at 60^{0}C temperatures in presence of Binary mixture of oxidants

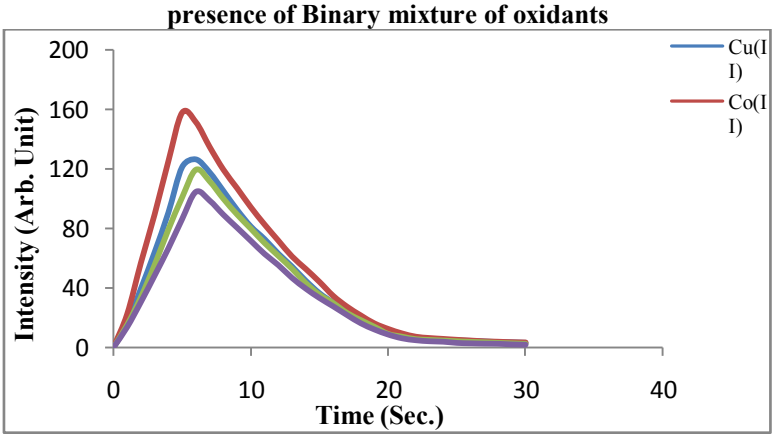
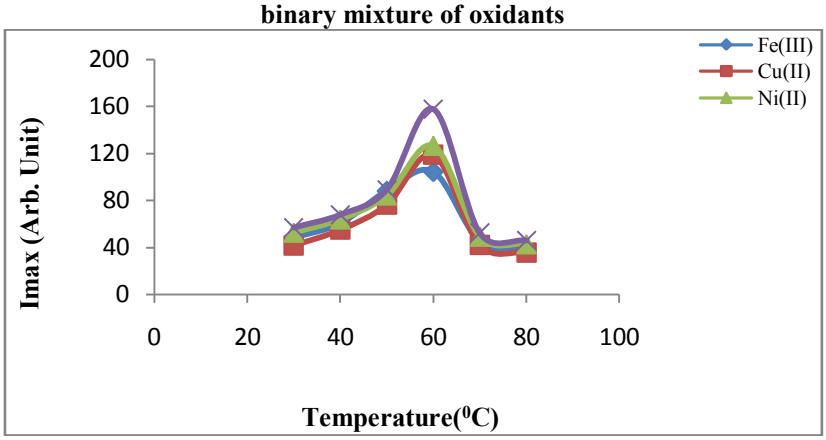


Fig. 2: Effect of temperature on peak CL intensity for Luminol Aqeous Ethyl amine (EA) in presence of binary mixture of oxidants



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