Enhanced chemiluminescence of luminol-hydrogen peroxide using copper as a catalyst

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The chemiluminescence (CL) emission spectra of luminol in aqueous calcium and barium hydroxide $Ca(OH)_2$ and $Ba(OH)_2$ has been recorded using Cu^{2+} ions as a catalyst and hydrogen peroxide as an oxidant. The chemiluminescence intensity is enhanced by the addition of Cu^{2+} ions. The microphotometric traces of CL emission spectra recorded are re-plotted on a linear wavelength scale. Two emission bands at ~430 and ~460 nm have been observed. On the basis of CL emission spectra resolution, the mechanism has been explained.

Introduction

Luminescence is the term used to describe the emission of light, which occurs when a molecule in an excited state relaxes to its ground state. The types of luminescence differ from the source of energy obtained in the excited state. Chemiluminescence (CL) is defined as the emission of ultraviolet, visible or infra-red radiation from a molecule or atom resulted due to the transition of an electronically excited state, produced as a result of a chemical reaction. There are two main categories of chemiluminescent reactions namely, direct and indirect CL. The intensity of CL emission depends upon the rate of reaction and the efficiency of the process achieved from the excited species. The mechanism is explained depending upon the number of excited species obtained.

Experimental

Materials and Methods:

All the chemicals used are of AnalaR grade. Luminol is procured from Koch-Light Laboratory, England which is used without further purification.
The CL intensity of luminol in alkaline metal hydroxide [$Ca(OH)_2$ and $Ba(OH)_2$], in presence of catalyst (Cu^{2+} ions) is monitored by the addition of hydrogen peroxide used as an oxidant. The CL intensity increases in presence of catalyst used (Yeh et al. 2005).

Results and Discussion

The CL of luminol has been studied in various alkalis using hydrogen peroxide as an oxidant and Cu^{2+} ions as a catalyst. The microphotometric traces being obtained are non-linear in wavelength, which are re-plotted on a linear wavelength scale with the help of calibration curve (Fig.1). The spectra are resolved on microcomputer. The analysis, of emission range, band maxima, half band widths, and the relative peak intensity are summarized in Table 1. Appropriate mechanism has been explained depending up the excited species formed.

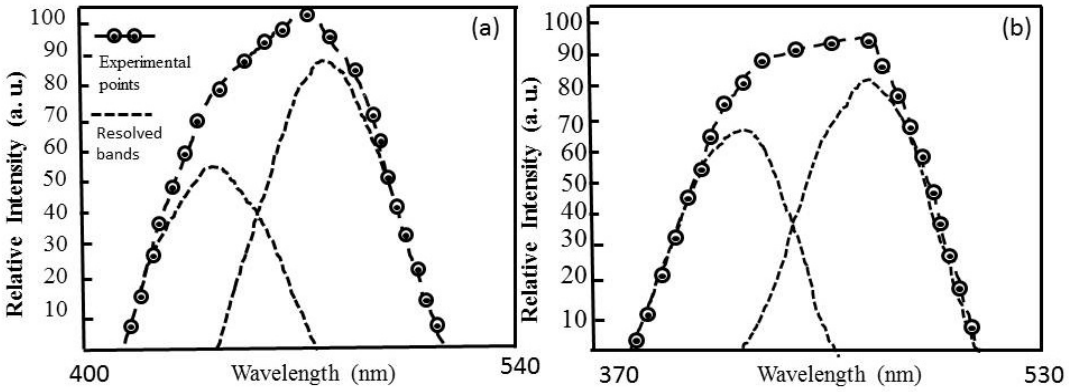

Fig.1. *Resolved CL emission spectrum of luminol in $Ca(OH)_{2\ plus}$ Cu^{2+} ions in presence of H_2O_2.*

Alkaline metal hydroxides	CL emission	Emission range (nm)	Band maximum (nm)	Band half-width (nm)	Relative peak intensity (a.u.)
$Ca(OH)_2$	Observed	405-503	463	43	98
	Resolved	405-463	433	22	53
		434-503	464	24	84
$Ba(OH)_2$	Observed	404-506	463	42	96
	Resolved	404-465	430	22	68
		435-506	464	24	85

Table 1. *Shows the analysis of CL emission spectra of luminol in $Ca(OH)_2$ and $Ba(OH)_2$ using hydrogen peroxide as an oxidant and Cu^{2+} ion as catalyst.*

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Reference:

Yeh H-C, Hsu W-T, Lin W-Y (2005) Enhancement in chemiluminescence by carbonate for cobalt(II)-catalyzed oxidation of luminol with hydrogen peroxide. J Chin Chem Soc-Taip 52:657–664