LETTERS TO THE EDITOR

QUALITATIVE ANALYSIS OF BINARY MIXTURES BY FLUORESCENCE POLARIZATION

FLUOROMETRY has been found to be an extremely sensitive technique in comparison with the absorption spectrometry for non destructive detection of different components in a mixture. But in cases where the emission spectra from different species overlap, this method does not work and more sophisticated techniques like 'selective modulation'[1] and 'derivative luminescence spectrometry'[2] have to be used if prior separation is to be avoided. This note suggests an alternative simple method for identifying the existence of each component in a binary mixture by observing the polarization spectrum.

In the present investigation, two binary mixtures *viz.* (*a*) eosin and erythrosin (conc. $\sim 4 \times 10^{-6}$ g/cc) and (*b*) fluorescein and rose bengale (conc. $\sim 6 \times 10^{-6}$ g/cc) in glycerine–water mixture (50–50% volume) are studied. The choice of glycerine–water mixture is to increase the value of percentage polarization which is generally low in aqueous solutions. The two components are mixed in suitable proportions so that their fluorescence intensities are comparable. The polarization of fluorescence for the mixtures as well as for the individual components are recorded at $\sim 30^\circ$ C with an Amino Bowman Spectrophoto–fluorometer using the relation[3]:

$$P = \frac{I_{LE} - G\, I_{LB}}{I_{LE} + G\, I_{LB}}$$

In order to excite both the components of the mixture simultaneously, the excitation wavelengths chosen were (*i*) 490 nm for the mixture of eosin & erythrosin and (*ii*) 500 nm for the mixture of fluorescein and rose bengale. Keeping the excitation monochromator fixed, the emission monochromator was varied from 510 nm to 570 nm and the percentage polarization for the mixture determined. The results obtained are shown in Figs. 1 and 2 respectively. Similarly, the percentage polarization for eosin, erythrosin, fluorescein, and rose bengale were also determined for the aforesaid excitation wavelengths within the fluorescence band 510 nm–570 nm. The percentage polarization in all the four cases did not change with the emission wavelength and was found to be constant with average values 12, 27, 6 and 10 respectively.

From Figs. 1 (A) and 2 (A) it is obvious that the fluorsecende emission curves for the mixtures are broad and the peaks are not resolved but the polarization spectra (Figs. 1B & 2B) have two clear steps corresponding to each component in the mixture: (a) Between 520 nm–532 nm (average % polarization, 12·1) for the mixture of eosin and erythrosin (Fig. 1B) and between 510–530 nm (average %

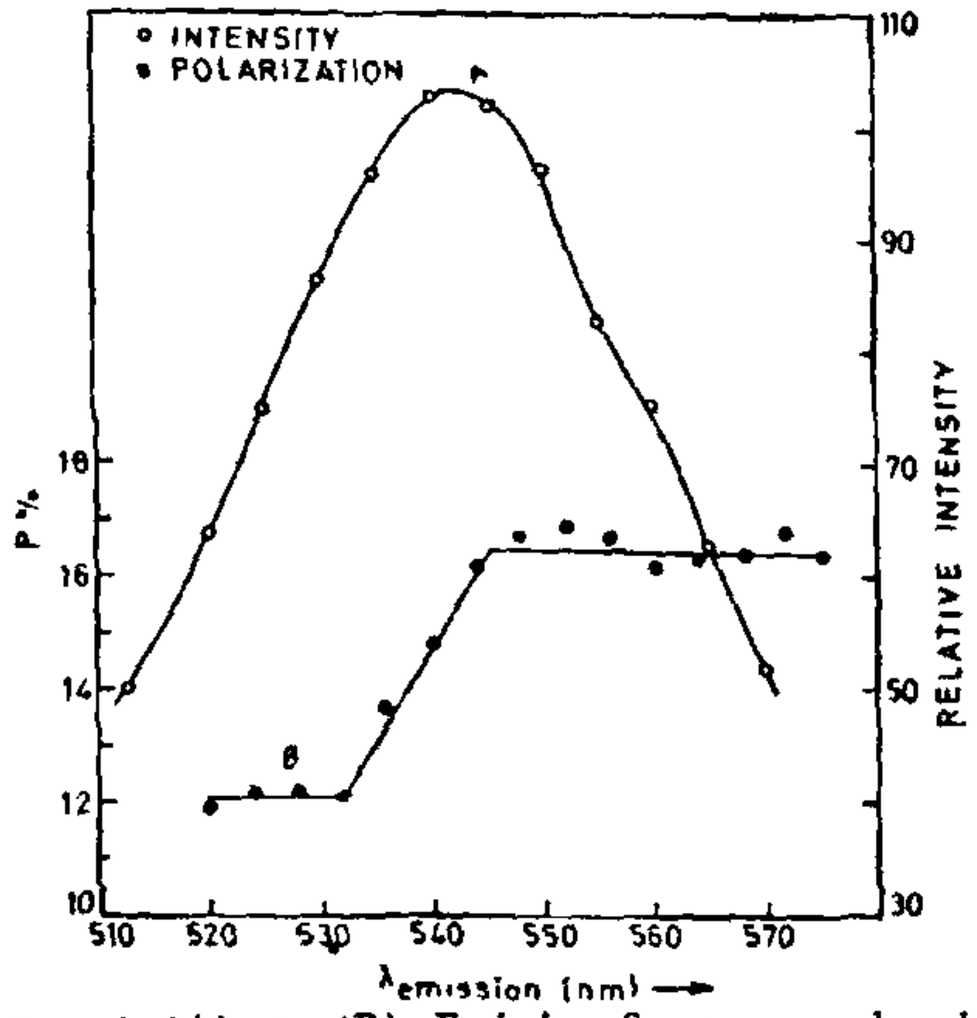

FIG. 1 (A) & (B) Emission Spectrum and polarization spectrum for the binary mixture of eosin and erythrosin for $\lambda_{ex} = 490$ nm.

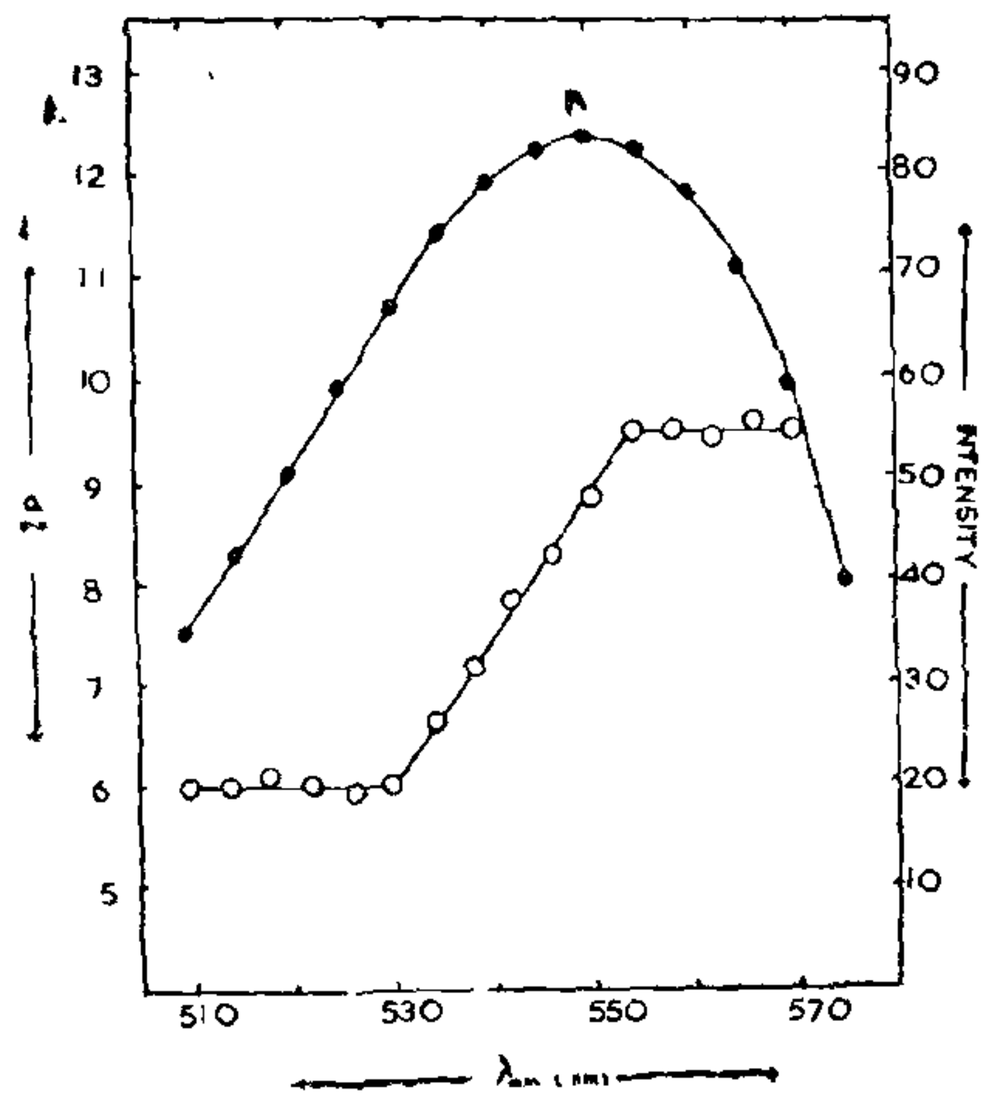

FIG. 2 (A) & (B) Emission Spectrum and polarization spectrum for the binary mixture of fluorescein and rose bengale for $\lambda_{ex} = 500$ nm.

polarization, 6) for the mixture of fluorescein and rose bengale (Fig. 2B). These may be due to the predominant contribution from eosin and fluorescein respectively. (*b*) Between 545 nm–570 nm (average % polarization, 16·5) for eosin–erythrosin mixture and between 554 nm–570 nm (average % polarization, 9·5) for fluorescein–rose bengale mixture. These correspond to contribution from erythrosin and rose bengale respectively. Between 532 nm–545 nm (Fig. 1B) and between 530 nm–550 nm (Fig. 2B), the variation in percentage polarization is due to the simultaneous emission from both the species of the mixture.

Thus the present work suggests the possibility of qualitative analysis of binary mixtures by the use of fluorescence polarization spectrum. This method can be extended to study the effect of aggregation of molecules at higher concentration[4].

Department of Physics and Astrophysics,
Delhi University,
Delhi 110 007.
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M. L. PANDYA*.
M. K. MACHWE.

* Permanent address: Department of Physics, M. M. College, Modinagar (U.P.).

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STUDIES ON ELECTRICAL RESISTIVITY OF PALLADIUM-SILVER BIMETALLIC THIN FILMS

PALLADIUM and silver are completely missible in the solid state[1,2]. This enables the process of interdiffusion between the layers of Pd and Ag even at 250° C. The mechanism as interdiffusion is exploited to prepare the bimetallic films of Pd and Ag by sandwiched evaporation in which a film of Ag is deposited between the Pd films. The present communication includes the method of preparation of samples and their electrical resistivity.

The samples were prepared on clean glass substrates of 4 × 2 cm.^{2} by vacuum evaporation at less than 10^{-4} Torr, using the conventional high vacuum system. The substrate was cleaned by a suitable detergent, rinsed with isopropyl alcohol and heated for 3 hours at 180° C.

In the sandwiched type of deposition, for preparing the Pd/Ag bimetallic films, the components were deposited in the order: Pd, Ag, Pd, from a tungsten filament. Each film of Pd/Ag/Pd was then annealed at 250° C in a furnace until the resistance attained a stable value; thus indicating that the interdiffusion phenomenon had ceased. The thickness of each layer was determined by differential weighing in a microbalance. The bulk density was assumed to calculate the thickness of each metal[3]. The percentage concentration of Ag was determined from the known weights of each substance. The electrical resistance was measured by standard four probe method[4] at 303° K under atmospheric conditions.

Figure 1 shows the change of resistance of the deposits with the annealing time. The interdiffusion at the beginning is rapid and then becomes almost steady, after 1 h of annealing. The values of resistivity of some samples with different percentages of Ag by wt. are given in Table I. The thickness of the samples is nearly the same (~800 Å).

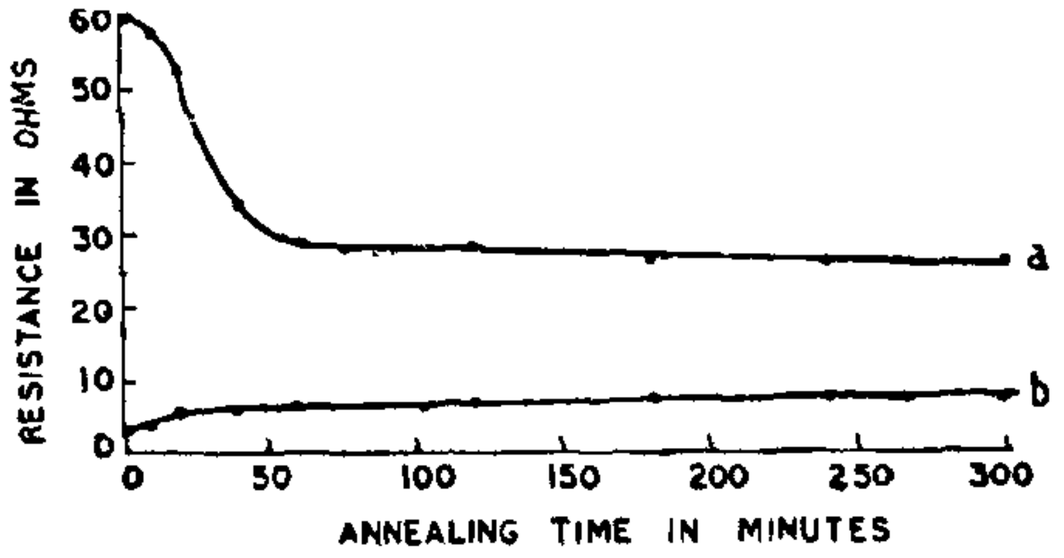

FIG. 1. Change in resistance during annealing at 250° C, the thickness of Pd–Ag–Pd layers being in the order:
(*a*) 235 Å, 27 Å and 493 Å and
(*b*) 570 Å, 163 Å and 46 Å.

TABLE I

The values of resistivity of some samples with different percentage of silver by wt.

% of Ag by wt. in Pd-Ag bimetallic films	Resistivity in μ ohm cm
3·0	82·62
13·2	63·90
25·0	59·34
55·0	48·07

The values of the resistivity are higher than those reported by Jackson *et al*[3]. The higher values of resistivity may be due to the formation of oxide layer over the films which are heated in air. Further, as the films are taken out of vacuum for weighing