CHAPTER - V

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The anthracene is basic fluorescent compound and its fluorescence is quenched by presence of other impurities. The increase in intensity (enhancement) of anthracene is not yet reported in the literature.

The excimer and exciplex formation between donor and acceptor have been reported incase of several aromatic hydrocarbons and their substituted compounds in the different solvent media. The formation of these species is known to occur by transfer of electron or excitation energy between two components and by the overlapping between two molecules. The formation of exciplex between two components in crystalline state is also reported in some polynuclear aromatic hydrocarbon systems. Hence very little effort has taken to investigate formation of such species in the excited state and to study their emission behaviour. The excimer, exciplex and charge transfer complex (CT) formation in the excited state can be made more probable by using more than one impurities in the basic aromatic hydrocarbons. With this view the multicomponent systems were prepared by using PAHs such as anthracene, perylene, pyrene and naphthalene. The excitation and emission properties of these luminophors were studied systematically and reported in the present work. The present work is based on the fluorescent properties. Hence basic aspects of (luminescence) fluorescence defined initially and hence literatures on aromatic hydrocarbons, other similar types of organic systems and parameters affecting the fluorescence are given.

Experimental :

Polynuclear aromatic hydrocarbons used in the present investigation were purified by column chromatography. Purity of compounds were further tested by taking their fluorescence spectra. Organoluminophors containing two and three components were synthesized by using doping thechnique. Following two component and three component mixed luminophors were prepared.

1) Pyrene doped anthracene.
2) Anthracene doped naphthalene.
3) Anthracene host containing pyrene and perylene guests.
4) Naphthalene host containing anthracene and perylene guests.

Calculated quantities of host and guest or guests were mixed intimately, placed in silica crucible and heated into the electrical furnace to get melt. The melt was cooled slowly to room temperature. The content of crucible was crushed to fine powder. The components form a solid solution hence the mixed organoluminophors are solid solutions. The formation of solid solution was confirmed by XRD studies. Absence of additional lines on XRD pattern of mixed luminophors indicates the formation of solid solution of components in the mixed crystal system. However, when solubility limit exceeds, the guest components forms separate molecular planes and XRD patterns of mixed crystal luminophors shows additional lines. The lines on the XRD patterns were indexed on the basis of $\mathrm{Sin}^2\theta$ method.

Fluorescence spectra of anthracene mixed crystals :

The fluorescence spectrum of crystalline anthracene shows a considerable stokes shift from its excitation (absorption) spectrum. The prominent fluorescence band occurred at 425 nm. while $0 \longleftarrow 0$ transition band is weak and occurred at 447 nm. The addition of pyrene enhance the fluorescence of anthracene. The intensity of both bands of anthracene was increased. It was also noted that at higher concentration of pyrene, the intensity of fluorescence of anthracene was quenched. The enhancement effect is explained on the basis of triplet-triplet annihilation process occuring between anthracene triplet and pyrene triplet to produce first singlet excited anthracene molecules. When another impurity of perylene was added into pyrene doped anthracene, the enhancement effect disappears. The fluorescence spectra of anthracene mixed crystal containing pyrene and perylene show monomeric perylene emission band and quenching of anthracene emission band. Perylene monomeric emission band appears due to transfer of excitation energy from anthracene to perylene molecules. This cause also explains the quenching of anthracene emission band. At higher concentration of perylene, the broad structureless emission band occurs at 510 nm due to exciplex formed between excited perylene and ground state pyrene molecules. Thus three component luminophors prepared by using anthracene, pyrene and perylene found to emit in the different region of visible spectrum. Hence by proper control of concentration of pyrene and perylene it is possible to synthesize luminophors emitting with different colours in the visible range.

The fluorescence spectra of naphthalene mixed crystals :

Naphthalene also shows a pronounced stokes shift in its excitation and fluorescence emission spectra. The naphthalene is observed to emit in ultraviolet region. The spectrum of naphthalene was modified by adding anthracene impurity. The fluorescence spectra of anthracene doped naphthalene shows anthracene like emission and intensity of bands are greater than the intensity of fluorescence bands in pure anthracene. The naphthalene fluorescence is completely quenched by the anthracene. The 10^{-2} mole per mole is the optimum concentration of anthracene in naphthalene at which intensity of anthracene like emission is found to maximum. At higher concentration of anthracene the quenching of fluorescence was observed. It is worthwhile to note interesting optical properties shown by naphthalene when doped by anthracene and perylene simultaneously. The fluorescence spectra of these multicomponent luminophors show anthracene like emission followed by broad tail centred at 520 nm towards red. This broad structureless band is attributed to heteroexcimer or CT-complex formed between excited perylene and anthracene moieties. The intensity of broad band increases with concentration of anthracene. This indicates that heteroexcimer is formed between perylene and anthracene only.

We expect that these studies will be very helpful in understanding intramolecular energy redistribution, formation of exciplex and heteroexcimer or CT-complex.