INTERNATIONAL JOURNAL OF RESEARCHES IN BIOSCIENCES, AGRICULTURE AND TECHNOLOGY
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www.vmsindia.org

Luminescence and Thermal studies of Bromide activated Diphenyle Quinoline

D. M. Pimpalshende
Dr. Ambedkar College of Arts, Commerce and Science, Chandrapur
dewrao.pimpalshende@gmail.com

Abstract:
The most of the essence for the next generation display is flat panel and energy saving. Organic thin layers and polymers are found to be valuable for these displays. Bromide activated diphenyle quinoline was synthesized and characterized by PL, thermal resistivity and dielectric. In this paper, synthesis in brief, luminescence study, dielectric constant and resistivity with respect to temperature is reported. The photoluminescence properties and thermal stability of synthesized material may find application in FPD, OLEDs and sensors etc.
Keywords: Synthesis, PL, Dielectrics, OLEDs.

1. Introduction:

The luminescent material is the heart of display devices which generates a colour of emission depending upon excitation. Among the many, primarily used luminescence for display devices are Electroluminescence (EL) and Photoluminescence (PL). Photoluminescence is the emission of light resulting from recombination of electrons and holes generated by electric field in concentration greater than the statistically permitted at thermal equilibrium. EL is the phenomenon in which electrical energy is converted in to luminous energy without thermal energy generation.

Photoluminescence (PL) is excited by photons. The general mechanism of phosphor is that a doped emission center in the host has different electron energy levels. By absorption of excited photons, the electron on the lower (ground) levels excited to higher energy level which is unstable state. After a life time on that level typically from 1ns to 10ms, the electrons return to the ground state by emitting photons. The colour of emission depends upon energy of photons.

There is an enormous demand for advanced visual displays in the information age. Portable wireless communication devices need sophisticated low-power, colour flat-screen displays. Flat screen displays for mobiles, computers and televisions are in high demand. There is, therefore, a great interest in the developing OLED technology to produce low power, high-definition, and flat-screen visual displays. Organic EL devices would be used as a new flat display since Tang et al and Adachi et al reported on high performance organic EL devices [1, 2]. The feature of organic EL devices is low drive voltage, high luminance and multicolor emission. The organic EL devices are able to produce all emission colour in accordance with a wide selection of organic emitting materials. There are few materials which emits red or green basic colour but blue emitting materials is found to be rare. Several blue emitting material like a metal chilates, anthracene derivatives, doped quinolenes etc were used for fabricating blue OLEDs [3]. Here blue emitting Bromide activated diphenyle quinolene is characterized by optical and thermal studies.

2. Synthesis of Br-DPQ:

Bromide activated diphenyle quinolene (Br-DPQ) was synthesized according to scheme given in reference [4]. In the method, 2-Aminobenzophenon and p-bromo-acetophenon 2gm each were added along with the 2gm of diphenylphosphet (DPP) using m-cresol as a solvent. The mixture was heated at 90^0 C in presence of inert gas for 1 hr and then at 140^0 C constant temperature for 5 hrs. The final product obtained in off white colour was washed, dried and used for the characterization.

$$C_{13}H_{11}NO + C_8H_7BrO \xrightarrow[\text{Inert gas /140 C}]{\text{DPP + m-Cresol}} C_{21}H_{14}NBrO + H_2O\uparrow$$

3. Characterization and discussion:

3.1 Optical Study:

The optical property of Br-DPQ was measured in acetic acid. Absorption spectrum of Br-DPQ in acetic acid at 1 mole concentration is as shown in figure 1. The absorption spectrum of the compound in acetic acid shows two bands, one at 260 nm and the other at around 370 nm. The compound shows evidence of solvent chromatics and the absorption bands are narrower without any vibration in structure. The breadth of the absorption bands can be recognized to planarity of the molecules caused by the interactions within the molecule.

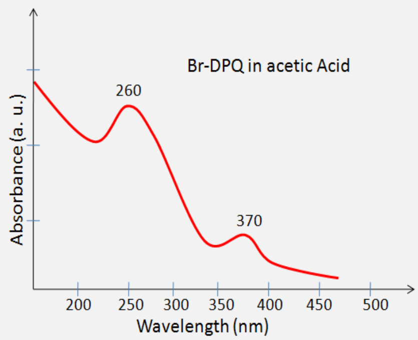

Fig. 1: Absorption spectra of Br- DPQ in Acetic acid

The excitation spectra of Br-DPQ in acetic acid show a peak at 370 nm as shown in figure 2. When the powder in acetic acid is excited at 370 nm, it emits intense blue light of wavelength 432 nm along with the other peak at 405 nm as shown in figure 3. This reveals that the synthesized powder can be excited in ultraviolet region emitting the intense blue light. The absorption, excitation and emission spectra of the compound in the different solvents and different mole concentration may change the wavelength slightly but in same blue region [5-8].

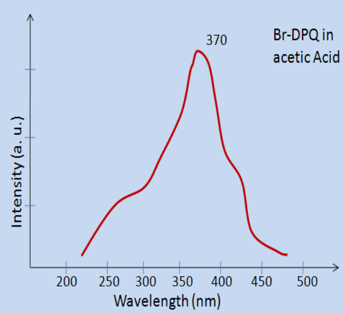

Fig. 2: Excitation spectra of Br- DPQ in Acetic acid

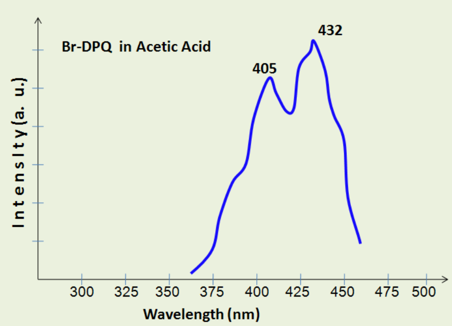

Fig.3: Emission spectra of Br-DPQ in Acetic Acid

3.2. Thermal study:

To study the thermal variation of the synthesized compound, pallets were prepared and kept in between the two parallel plates to form a capacitor. Then it was kept in an electrically controlled oven and the capacity of a material was measured with the help of digital LCR meter against the temperature. Starting from the room temperature capacity and hence the dielectric constant was determined by increasing the temperature in a steps of 5^0C. The graph plotted between the temperature and dielectric constant (**ε_r**) shown in figure 4 reveals the dielectric constant increases linearly up to 120 ^{0}C and then it increases rapidly.

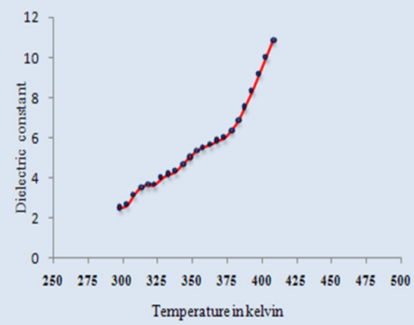

Fig. 4: Variation of dielectric constant with temperature

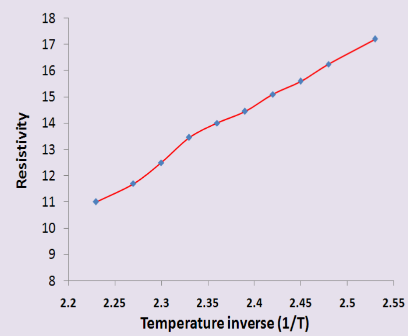

Fig. 5: Variation of resistivity with inverse of temperature

To study the thermal conductivity, the prepared sample in the form of pallet was kept in crystal holder (two probes) and inserted in electrically controlled oven for thermal variation corresponding to resistivity measured by LCR meter. The graph plotted between resistivity (ρ) verses inverse temperature (1/T) in degree Kelvin is as shown in Figure 5. The energy gap calculated from the slope using the equation E_g == 2k x slope (where k is 8.6×10^{-5} eV/K) found very large in the order of MeV. This reveals the synthesized organic materials tending toward the insulating behavior.

3.3 Conclusions:

The optical properties like absorption, excitation and emission wavelength of Br-DPQ synthesized here are exactly similar to that of DPQ reported earlier. The dielectric constant varies with temperature in linear and rapid change behavior. The thermal variation of organic materials observes insulating properties. The compounds show strong blue emission under UV source. Br-DPQ is found to be blue light emitter and can be used in OLEDs. The intensive blue colour emitting OLEDs can be used commercially in display and lighting applications.

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