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Development of Blue Emitting Organic Phosphors of Diphenylquionial (DPQ) Group for OLED

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Abstract: *A Series of blue emitting organic phosphors and its derivatives with different combinations were synthesized in an argon atmosphere at 1400C by Friedlander Condensation method and are tested chemically for its solubility in acidic and basic and emitting blue color under UV. The structural changes take place in DPQ an organic phosphor. The structural, optical and chemical properties of all the derivatives of diphlnylquioline (DPQ) were studied from various characterizations. It shows the stability of characterized organic polymers. The physical and chemical study shows more effectiveness with large applications to emit blue light for organic display system.*

Keyword: Friedlander Condensation method, Synthesis, Characterization, Solid state lighting

I. INTRODUCTION

Organic polymers are promising materials used as an active layer in optoelectronic devices [1-7] such as the field–effect transistors [8], light–emitting diodes [9] and photovoltaic cells [10].Most organic semiconductors are based on n-conjugated molecules ranging in size from small molecules to polymers. Important advantages of using organic materials rather than inorganic semiconductors are the relatively low production and processing costs, flexibility and light weight.

Organic semiconductors can often be processed from solution, using techniques such as spin coating or ink-jet printing. Some examples of typical organic conjugated polymers such as poly (para-phenylene) (PPP)[13], poly(para-phenylene vinylene) (PPV) [14], poly(para-phylene ethynlene) (PPE) [15,16] and polythiophene (PT) [17-19]. In display applications, it is essential to develop highly efficient and reliable device in all three primary colors (RGB). However, the luminous efficiency of blue and red OLED's still needs to be improved [20]. Color purity and stability of blue color remains a challenge.

Over the last three decades, poly (quinoline) has become the subject of intense research as electroluminescent materials for organic light –emitting diodes (OLEDs) thanks to their superior physical properties such as high electron mobility, photo luminescent efficiency, and stability. Electro active and blue light-emitting diphlnylquioline (DPQ) was synthesized in nearly quantitative yield by a simple modification of polystyrene. It emits blue light in neutral solution and thin solid films.

II. EXPERIMENTAL

The synthesis of organic phosphor materials diphlnylquioline (DPQ) and its derivatives is done by the method of Friedlander Condensation technique. In present work, diphlnylquioline and its three derivatives were synthesized by taking various combinations. All the materials taken are of A. R. Grade with high purity. Various combinations for the phosphor materials are summarized in TABLE-1.

Table-1

S. No.	Organic phosphor material	Combination for the synthesis	Quantity
1	Methyl diphlnylquioline (M-DPQ)	a. 2-Amino, 5- Chlorobenzo phenone. b. P-Methyl Acetophenon	2 gm 2 gm

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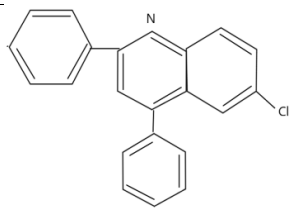
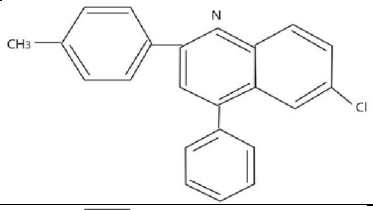
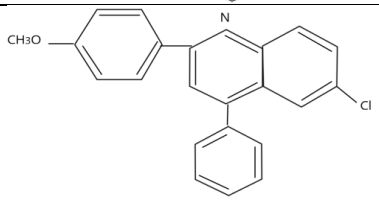
		c. Diphenyl Phosphate (DPP) d. m - Cresol	2 gm 3 ml
2	Chlorine Methyl diphlnylquioline (Cl-M-DPQ)	a. 2-Amino, benzo phenone. b. P-Methyl Acetophenon c. Diphenyl Phosphate (DPP) d. m - Cresol	2 gm 2 gm 2 gm 3 ml
3	Chlorine Mehoxy diphlnylquioline (Cl-MO-DPQ)	a. 2-Amino, 5- Chlorobenzo phenone. b. 4-Methoxy Acetophenon c. Diphenyl Phosphate (DPP) d. m - Cresol	2 gm 2 gm 2 gm 3 ml

Blue emitting organic phosphors Methyl diphlnylquioline (M-DPQ), Chlorine Methyl diphlnylquioline (Cl-M-DPQ) and Chlorine Mehoxy diphlnylquioline (Cl-MO-DPQ) with different combinations were synthesized in an argon atmosphere at 90^0C for one hour and then at 140^0C for four hours under Argon atmosphere in oil bath. After five hours, three neck flasks were kept outside the oil bath for cooling up to 24 hours. Two layers were seen after shaking and adding dichloromethane and sodium chloride with proper proportion.

All the organic phosphors were purified and converted into a crystalline powder by applying proper method explained in Friedlander Condensation method [21] with the help of dichloromethane (DCM), 10% NaOH solution, distilled water , MgSO4 and hexane. Solubility of all the phosphors was tested in acidic acid, formic acid, tetrahydrofuran (THF), chloroform, etc. The organic phosphors were tested for their color of emission under UV and it shows blue color emission. It confirms that these phosphors are useful for organic light emitting diodes 9OLED) and also for flat panel display. The structure of all the organic phosphors with their various parameters are summarized in Table-2

Table-2

S. No.	Organic phosphor material	Structure	Emission (nm)	Excitation (nm)
1	Methyl diphlnylquioline (M-DPQ)		406	370
2	Chlorine Methyl diphlnylquioline (Cl-M-DPQ)		442	365
3	Chlorine Mehoxy diphlnylquioline (Cl-MO-DPQ)		440	365

III. Result and Discussion

The derivatives of organic phosphor materials diphlnylquioline (DPQ) is synthesized by the method of Friedlander Condensation technique with proper combinations. After purification of the product a crystalline solid material was

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obtained in the form of powder. Whether The product obtained is soluble or not can be confirmed by using various chemicals such as acidic acid, formic acid, tetrahydrofuran (THF), chloroform, distilled water, etc. It is found that the synthesized organic phosphors are better soluble in various chemicals for blue emission under UV.

The physical, optical and chemical properties were studied by taking various characterizations such as, absorption spectra, PL spectra by spectrometer, X-Ray diffraction spectra, FTRA spectra, TGA and SDTA. The PL spectra show better emission in the range of 406 to 442 nm with the excitation range 365 to 370 nm. TGA and SDTA curve shows that the synthesized product is stable up to the range of 239^0C with melting temperature at 1240C, 130 ^{0}C and 137^0C respectively. Other parameters like decomposition temperature, activation energy also studies from the spectra's and the curves of synthesized phosphors.

Hence, the synthesized phosphors are used for the emission of blue color light in organic light emitting diodes. All the three organic products show better results with reference to optical, physical and chemical properties for the applications in the field of flat panel display technology.

IV. Conclusion

We synthesized a novel series of blue emitting diphenylquinoiline and its derivative in nearly quantitatively yield. These organic phosphors were synthesized by attaching chlorine methoxy and methyl to the main chain of DPQ organic phosphors. They show strong emission in blue color under UV source in different solvents showing excellent solubility in acidic and basic media. The result of all phosphors regarding structural conformation, thermal stability, optical and chemical properties shows expected results. All the polymers M- DPQ, Cl-M-DPQ and Cl-MO-DPQ are blue emitting materials in various solvents. Hence, DPQ complexes have a great potential as blue emitter for OLED applications. Although there are some challenges in the field, the future for OLED's looks bright. The luminescent properties of these materials become thus of great interest for fundamental and applied research.

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