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Synthesis and Characterisation of Nipa Palm Extract as a Potential Emitting Material for Organic Light Emitting Diode

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Abstract
Organic light-emitting diode based on the principle of emissive electroluminescent layer is a thin film of organic compound which emits light in response to an electric current and are used to create digital displays and solid state lighting. The main objective of this thesis work is to synthesis and characterise nipa palm extract with spectrophotometer . A key issue associated with this research work is the determination of the peak absorbance for the seed and the husk solutions at 660nm and 580nm respectively . The phytochemical screening of the husk and seeds of Nipa fruiticans revealed the presence of polyphenols and tannins in the husk while the seeds showed traces of alkaloids. Thus, the nipa palm seed and husk material have potential applications of red and yellow colours OLED which guarantee good color stabilization.
Keywords- electroluminescence, cobalt salt, ferrous salt, Nipa palm, spectrophotometer.

1. Introduction

Electroluminescence is the production of light by the flow of electrons, as within certain crystals without thermal energy (1). It is an optical and electrical phenomenon in which a material emits light in response to the passage of an electric current or to a strong electric field. (7) Here, direct conversion of electric energy into visible light takes place without the generation of heat . Electroluminescent devices are fabricated using either organic or inorganic electroluminescent materials according to the nature of fluorescence and phosphorescence in materials.

Inorganic electroluminescent materials are key components which were, are and will be prerequisite to the functionality and success of many lighting and display systems. According to Torben, (5), like a capacitor, an electroluminescent material is made from an insulating substance with electrodes on each side. One of the electrodes is transparent and allows the light to pass. The insulating substance that emits the light can be made of zinc sulphide or a combination.

An organic electroluminescent element is the electrically driven emission of light from non crystalline organic materials, composed of a very thin organic compound layer (an organic functional layer) including a fluorescent or a phosphorescent light emitting layer sandwiched between a first electrode (anode) and a second electrode (cathode), and emits light by applying an electric current to it. Generally, an organic substance is an insulator. Some examples of organic electroluminescent materials are:

1.Oligomer Electro Luminescence Materials
- 8-hydroxyquinoline aluminum
- Anthracene
- Pentacene
- Penyl substituent cyclopentadiene derivatives

2.Polymer Electro Luminescence Materials
- Polyaniliness
- Poly(p-phenylenevinylene)s
- Poly(thiophene)s
- Poly(alkylfluorene)s

1.1 Nipa Palm: A Possible Organic Electroluminiscent Material (OEM)

Nipa palm is an angiosperm species assignable to modern genus found in the tropical areas, in the wild estuary. Nipa is classified in the kingdom of PLANTAE, in the phylum of TRACHEOPHYTA, in the class of LILIOPSIDA, in the order of ARECALES, in the family of PALMAE, and its scientific name is Nypa fruticans. The Nipa Palm (*Nypa fructicans*, Wurmb.) is the only palm that can be found in most tropical mangrove systems (2). The picture in figure 1. shows the plant, fruit and seed.

Figure 1: The Nipa Palm, Flowers and its Fruits

The phytochemical characterisation of the husk and seeds of Nypa fruiticans revealed the presence of polyphenols and tannins in the husk while the seeds showed traces of alkaloids. Flavonoids, anthraquinnins were noted to be absent in Nypa fruticans (Osabor et al, 2008). Nipa palm seed was found to show good electrical insulating properties. Within the ambit of experimental accuracy Ukpong (6), in his work, a study of the electrical properties of nipa palm seed, observed that nipa palm seed have very high bulk resistivity of about (1.90 – 3.80) x 10^6 Ωm, conductivity range (2.5- 5.2) x 10^{-7} Ωm^{-1} . Its resistivity is very high while the conductivity is very low. Electrons tunnel from electronic states at the insulator/phosphor interface is a necessary step to produce electroluminescence

These results on the characterisation of the various parts of the nipa palm indicate that nipa palm should be adequate for electroluminescent (emitter layer) applications since it agrees with the *general Organic Light Emitting Diode material requirements of* adequate conductivity.

Most of the reported electroluminescence of organic compounds in OLEDs are either organic aromatic molecules or organic polymers. (4). This ignited the passion to try some organic materials in this environment such as nipa palm seed and husk to see whether they can perform in this application or not. The work reported in this Thesis is therefore motivated by the possibility of synthesizing and characterizing nipa palm seed and husk solutions as a potential emitting material for an organic light emitting diode

Nipa palm may be most valuable if its parts are harnessed for use in the electronics industry specially, in organic electronics. This is because OLED (Organic Light Emitting Diode) technology faces a bright future in the display market, as the ever-changing market environment appears to be a global race to achieve new success. Eventually, the technology could be used to make screens large enough for laptop and desktop computers .Because production is more akin to chemical processing than semiconductor manufacturing, OLED materials could someday be applied to plastics and other materials to create wall-size video panels, roll-up screens for laptops ,and even head wearable displays.

2. Methods

The epicarp of the seed were cleaned to reveal an ivory-like endocarp (plant ivory) of the seed. These were then grounded and sieved to obtain smooth milky powdered seed. The nipa seed powder was then mixed with distilled water and boiled for five minutes. To ensure a homogeneous solutions, a general laboratory centrifuge with radius 15cm,was used to spin the sample solution in a revolution of 5000 rpm for 15 minutes . The nipa powder solution which is ready for use in the experiments is put in a sample bottles and stored in refrigerator .

The husks that was obtained were pounded with aid of mortar and pestle and solution was squeezed out with hands and put into a sample bottle. To ensure homogenous solution, general laboratory centrifuge with a radius of 15cm, spin the sample solutions in a Revolution of 5000rpm for ten minutes and stored in a refrigerator.

5000µg of cobalt ii nitrate hexahydrate salt was dissolved in 5ml distilled water, similarly 5000µg of ferrous sulphate heptahydrate salt was dissolved in 5ml of distilled water. To ensure homogenous solution, general laboratory centrifuge with a radius of 15cm, spin the sample solutions in a Revolution of 5000rpm for ten minutes.

2.1 spectrophotometry

1. Spectrophotometer was put ON and allowed to be stabilized for 15minutes.
2. A test tube was half filled with water into a cuvette and used to blank. The top of the cuvette was shut to adjust the instrument and to take readings, to prevent stray light from entering the instrument.
3. The needle was set at 100% transmittance using the light control.
4. The blank was removed.
5. The instrument now correctly calibrated. Test tube containing sample was placed in the machine and the lid was closed ; after 10 seconds absorbance and wavelength reading was recorded.
8. In order to take another reading on the same or different sample, the absorbance scale reading was checked that and ensured the transmittance reads 100% with the blank sample
9. The process was repeated with standard samples.

3. Results and Discussion

3.1 Spectral analysis of positive control solutions

The spectral characterisation of positive solutions of Nipa seed, Nipa husk, cobalt complex and ferrous complex are shown in table 1.and figure 2

Table.1 Absorption spectrum of Nipa palm seed and husk positive control solutions and ferrous sulphate heptahydrate, and cobalt ii nitrate hexahydrate positive control solutions

Wavelength (Nm)	Nipa Husk solution Absorbance	Nipa Seed solution Absorbance	Ferrous complex Absorbance	Cobalt complex Absorbance
300	0.814	1.105	1.195	0.921
340	0.982	1.1269	1.329	0.150
380	0.842	1.071	1.114	0.275
420	0.902	1.043	1.135	0.936
460	0.762	0.935	1.137	0.520
500	1.441	0.611	1.189	1.126
540	1.567	1.760	0.933	1.091
580	1.609	1.885	0.744	0.542
620	1.480	1.897	0.661	0.397
660	1.415	1.928	0.656	0.263
700	1.328	1.901	0.685	0.112

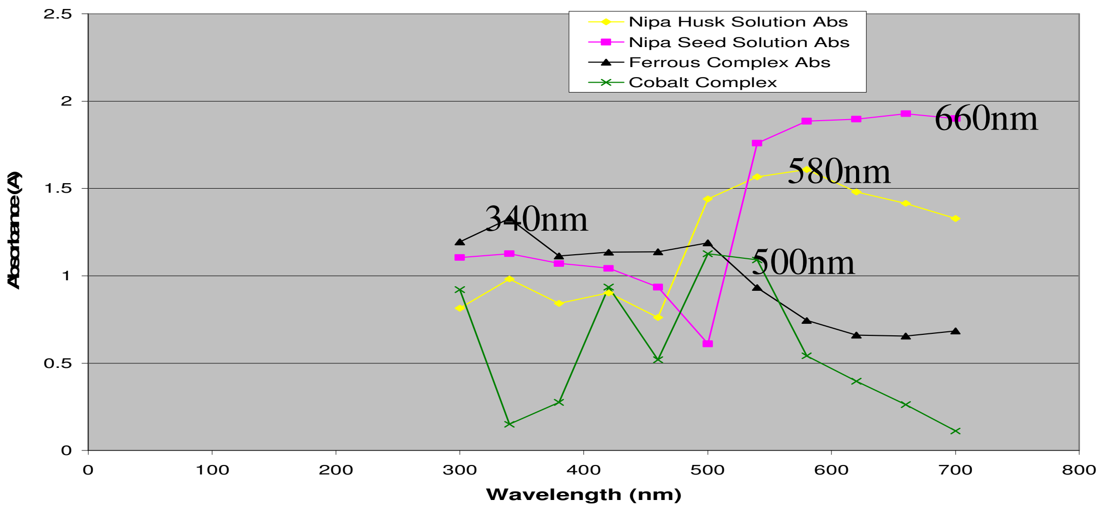

Figure .2 : Plot of Absorbance to wavelength of Nipa palm seed positive control solution which shows the peak wavelength at 660nm, Nipa palm husk positive control solution at a peak wavelength of 580nm, cobalt positive control at peak wavelength of 500nm and ferrous positive control solution at 340nm.

Analysis of Positive control solutions

The polymeric compounds of Nipa seed solution and the husk solution gave different absorption maxima (ʎmax) at 660nm and 580nm respectively. Figure2 shows that the absorbed colour for the seed is red while the absorbed colour for the husk is yellow. On the other hand, the absorbed colour for cobalt complex is green while that for ferrous complex is violet at wavelength of 500nm and 340nm respectively. The relationship between the frequency and the wavelength :

$\nu\lambda = c$ ………………………………………………………………… .1

Where ʎ is the wavelength, c is the speed of light 2.998×10^8 m/s ν is the frequency. Thus from the peak wavelength of 660nm for seed and 580nm for husk we can deduce that the frequency are 454242 Hz for the seed and 516897 Hz for the husk. This implies that the shorter the wavelength of electromagnetic radiation , the greater the energy, that's explained the reason for the greater energy of the husk. In a medium other than vacuum, the speed of light is

C/n………………………………………………………………………….2

Where n is the refractive index of that medium. For visible wavelengths in most materials , n > 1, so visible light travels more slowly through matter than through vacuum. Considering energy, it is more convenient to regard light as particles called photons. Each photons carries the energy, E, which is given by the relation between energy and frequency:

$E = h\nu$………………………………………………………………………..3

Where h is Planck's constant (6.626×10^{-34} J.s)

Thus the photon energy of the seed solution is 3.0×10^{-28} e V while the photon energy of the husk is 3.4×10^{-28} e V.

Hence , when nipa palm seed molecule absorbs a photon energy of 3.0×10^{-28} e V and the husk 3.4×10^{-28} e V the molecules increases and promoted to excited state. If the molecules emit a photon, the energy of the molecule is lowered and may gradually reduce to its ground state

Conclusion

This thesis report about new easy-to-synthesize red and yellow organic light-emitting material. The organic light emitting material is a potential candidates for range of photonics and opto- electronics applications because they can be well adjusted chemically to fit into commercial production.

REFERENCE

1. Alt, Paul M. (1984), "Thin Film Electroluminescent Devices, Device Characteristics and Performance," *Proceedings of the Society for Information Display*, volume 25, no. 2 ,pp123-146.
2. Hutton.W (1996): Tropical Fruits of Malaysia and Singapore.Periplus edition (UK) ltd pp.18-25
3. Osabor. V.N, Egbung.G.E, Okafor.P.C, (2008): Chemical profile of Nypa Fruticans from Cross-Rivers Estuary, South Eastern Nigeria. Pakistan Journal of Nutrition,. Volume 7(1) pp. 146-150
4. Shizuo.T, Noda.K, Hiro Mitsu.T(2000): Organic Light-emitting Diodes using novel metal-chelate complexes,Journal of Synthetic metals,vol111. Pp. 393-396
5.Torben Lenau (2003): "Electroluminescent materials" http://www.designinsite.dk/htmsider/m1327.htm

retrieved 20th February, 2013.
6.Ukpong Uwemedimo Essien(2009): A study of the electrical properties of Nipa seeds. An undergraduate unpulished work. University of Port Harcourt.
7.Wikipedia (2003): Free encyclopedia, electroluminescent files/ electroluminescent.Htm (03/10/2011)