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Optical Properties of CTA Natural Dye Coated Film exposed to Low Temperature Plasma

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Abstract : Cellulose Tri Acetate (CTA) film incorporating palash flower dye has been prepared by dip coating method and the optical properties has been investigated. In the Photoluminescence (PL) spectra of the CTA coated dye films, a peak at 603 nm and the visible emission peak at about 660 nm were observed, which were caused by palash flower dye. The CTA film coated dye was exposed to plasma for two different times for the comparison. The PL peak initially appearing about 550 nm broadened and moves to higher wavelength with increase in treatment time of plasma. On contrary, in the PL spectrum of the untreated and plasma treated film, the intensity of the emission band increases with increase in treatment time of plasma which can be caused by the incorporation of dye in to the film and surface treatment of plasma.

Introduction

The cellulose Tri Acetate film is used for fabricating thin films and the properties of CTA films have been reported already. One of the extended techniques enables the construction of Cellulose Tri Acetate films. The structural and optical properties of the Cellulose Tri Acetate films coated natural dye surface can be modified by the plasma treatment for different time of exposure.This method is highly advantageous for constructing new functional materials. The optical and structural properties of the Cellulose Tri Acetate film have been investigated. In this work, CTA films were coated by dye and treated with two different time of exposure .The fundamental optical properties (i.e) Adsorption and Photoluminescence were investigated.

Experimental details

The chemical structure of Cellulose TriAcetate (CTA) is shown in figure (1). Methylene chloride and Methanol was used as a solvent for the preparation of Cellulose Tri Acetate (CTA) film. The palash flower dye is awater soluble and the dye solution of $1x10^{-3}$ M was used to coat the CTA films. The Cellulose Tri Acetate film was first deposited by the dye solution in order to enable stable deposition. The palash flower dye coated Cellulose Tri Acetate film was treated with DC glow discharge plasma reactor for two different times and it is compared with untreated sample. It consists of a cylindrical stainless steel chamber of length 50cm and diameter 30cm .Two aluminium plates were used as anode and cathode.The pressureof 0.03mbar was maintained inside the chamber and it was measured by pirani gauge. At this low air pressure, dc voltage of 450v was applied between the electrodes to ignite the glow discharge. The samples were treated for twodifferent exposure time at low pressure level.

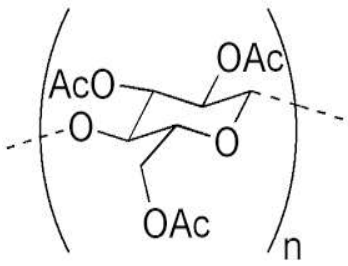


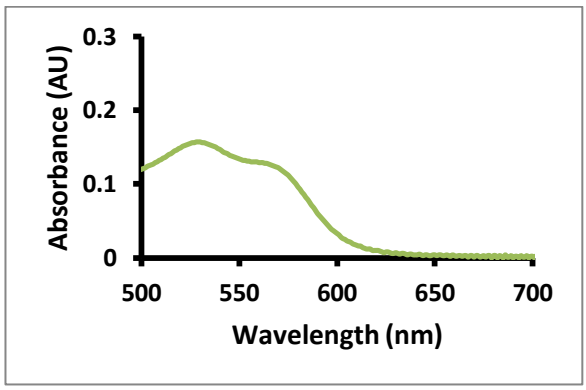
Figure (1) General structure of Cellulose Tri Acetate

The adsorption and PL measurements of the Cellulose Tri Acetate films coated natural dye for untreated and two different plasma treated film was carried out in order to investigate the fundamental optical properties. The adsorption spectra was measured byusing spectrometer ocean optics USB 2000 while PL emission spectra of the film was taken by a Hitachi 204 fluorescence spectrometer.

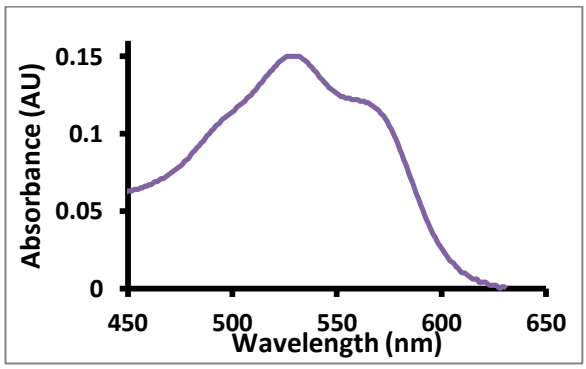
Results and Discussion

The adsorption spectra of the CTA films coated with natural dye is treated by plasma is shown in figure (2).The adsorption peaks are at 529,530,531 nm. This result indicates that the absorbance increases with the deposition of the dye and the plasma treatment have occurred reproducibly.

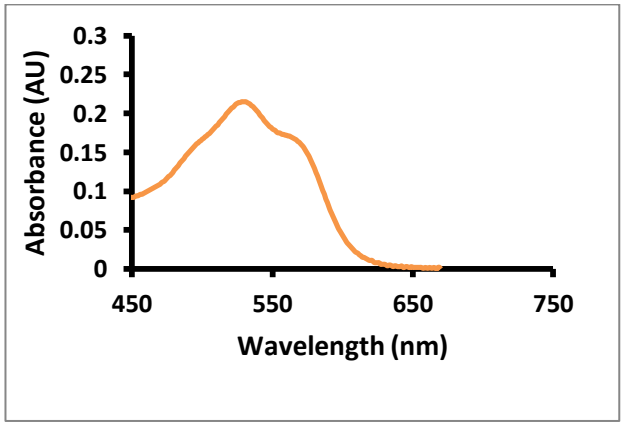
The results of the absorption and PL measurements for untreated and two different time of plasma treated samples are shown in figure (2)and (3) [1]. In the adsorption spectrum (fig 2a), the broad peak due to monomer and dimer of the untreated film is observed at around 529-575nm.The PL spectrum (fig 3a) has a broad peak at 600 nm . The adsorption and PL spectrum of treated film is shown in figures (2b, 2c,3b and 3c). The absorption spectrum of plasma



2(a) Absorption spectra of Untreated Film



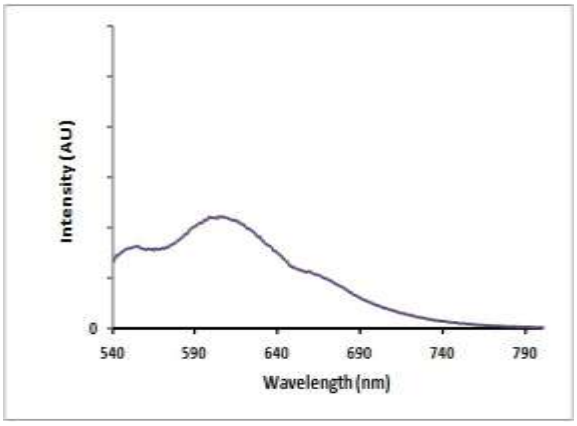
2(b) Absorption spectra of Treated Film (300 S)



2(c) Absorption spectra of Treated Film (600 S)

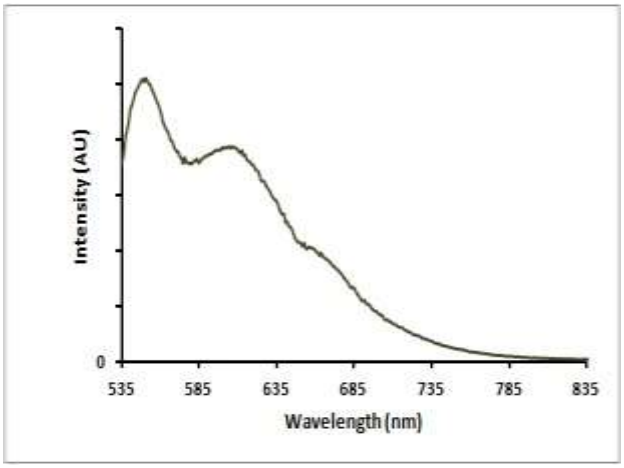
Treated film 300s has a peak at 530 nm which is due to incorporation of dye in to the film. The adsorption peak at 531 nm for 600s treatment time is due to aggregation formation of the dyes and the broad peak at 525-575nm is due to monomer and dimer of the palash flower dye [2-5].

In the PL spectrum, the narrow peak around at 550nm and weak peak at 600nm was observed. From figure (3b) and (3c) it was found that the peaks are at 525 and 600nm .The adsorption spectrum was similar to that of PL spectrum. From the results, the PL properties of the CTA natural dye coated films reveals the energy transfer takes between dye molecules.

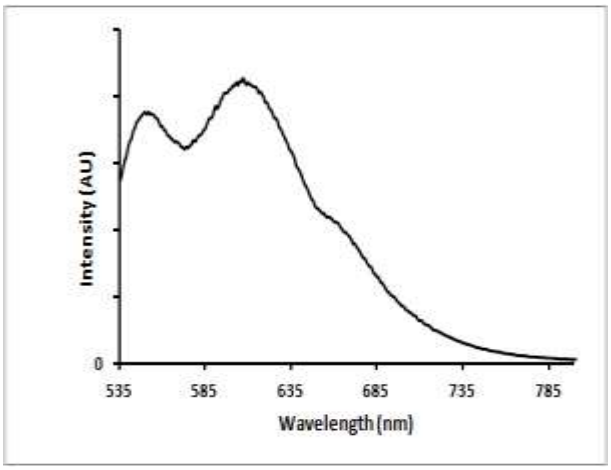


3(a) PL spectra of Untreated Film

Figure (3b) and (3c) shows the dependence of the PL spectra of the CTAnatural dye coated film treated with two different time of exposure of plasma. The PL peak at about 550nm was intense with increase in plasma treatment time. The PL peak at about 600nm was broadened and shifted to longer wavelength with increased radiation time. This phenomenon relates the energy transfer between the dye molecules caused by the plasma treatment.



3(b) PL spectra of Treated Film (300s)



3(c) PL spectra of Treated Film (600s)

Conclusion

The Cellulose Tri Acetate film was prepared and coated with palash flower dye. The optical properties were investigated .The intense peak at about 550nm and a narrow peak at around 600nm was observed, which were caused by the natural dye. The PL peak intensity at about 550nm was increased with increase in treatment time of plasma and PL peak appeared at about 600nm broadened and shifted hypsochromically with the treatment time. It was observed that the PL properties of the CTA natural dye coated film was related to energy transfer .Using the functional dye molecules, Interactions between the film and dye may be expected.

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