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Inclusion Behavior Of Organic Probe Inside Micellar Nano Cavity In Polymer Phase

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Abstract

Organic salt pyrrole-2 carboxaldehyde (PCL) was entrapped using polymer micellar system likeSodium dodecyl sulphate, (anionic surfactant), Polysorbate-80(non-ionic surfactant) along with polymers like polyethylene oxide (PEO). Synthesized and characterized using UV-Vis , FTIR, and fluorescence. The influencing factor in the determination of all the characterization was to check wheather polymer is able to hold the micelle formation occurring between the salt and surfactants used without interacting with them.

1. Introduction

Due to thewide-range of applicationsof organic materials on the nanometre size scale the desire to control their composition, function, and structure is receiving increasing interest from microelectronics to medicines. Using both of the covalent and non-covalent interactions, control has been achieved on the macromolecularsize and shape.The assembly of numerous small molecules are required for the application ofthese interactions to form structures with large nanoscale dimensions[1]

In order to make the synthesis possible of these nanostructures as definite entities, development of methodologies has been done to exploit covalent interactions in order of the formation of robust building blocks, such as block copolymers [1]. By means of non covalent interactions these can be designed, with a moderately small number of components, in order to form nanostructures, such as polymer micelles. This universal process is well known as the dimensional evolution of synthetic organic chemistry.

There is an important advancement inthe field of polymer science represented by the applications of these particular techniques towards thesimplistic synthesis of distinct functionalised hydrophilic and hydrophobic copolymers, which enables the construction ofpolymers which are having a great power of control over the molecular weight, sequence and end functionalisation, for operation in the selfassembly of well-defined nanostructures. Most accessible assemblies among all are Spherical polymer micelles and nanoparticles which are leading towards the significant potential in varying applications which are ranging from delivery vehicles for therapeutics,as precursors to nano-sizedmicroelectronic devices and molecular imaging agents.

One very important feature of using organic salts or different organic compounds is that carbon-carbonbonds are strong enough, so it is possible to form long chains or rings of carbon atoms which are bonded to one another. Organic chemistry is having a wide application range now a day in biotechnology, petroleum, pharmaceuticals and many other industries.

In our study we have used an organic salt called Pyrrole-2-carboxaldehyde (PCL) because of its wide application in the area of bio-medical field as it serves as a medicine for the cure of cancer and several electronic applications such as in making LED, SENSORS, OLEDS etc. The main problem which arises with PCL is that it can't be directly inserted in the human body because it is cytotoxic in nature and causes harm to the human body. Therefore, we take the help of miceller system to overcome this problem because it helps to entrap the PCL drug in the micelle formed by the interaction of PCL with the surfactants used above a certain CMC (critical micellar concentration) value and then it can be inserted in the human body and help to overcome the problem.

2.0 Experimental

2.1 Apparatus:

The UV-Visible absorption spectra were recorded at 300 Kelvin by a Perkin Elmer spectrophotometer (model Lambda-35) with a varying slit width. All luminescence measurements were made with aPerkin Elmer spectrophotometer (Model Fluorescence-55) with a varying slit width (Excitation slit=10. 0 nm and Emission slit=5nm) ranging from 190-900 nm. The Model LS 55 Series uses a pulsed Xenon lamp as a source of excitation. Deionized water (milipore) was used for measuring absorption and emission spectra. All optical measurements were performed at room temperature under ambient condition. IR spectra at ATR mode are recorded with a perkinelmer FTIR spectrometer (model spectrum BX-11 source: nichrome glower wire with DTGS detector) at 400-4000 cm^{-1} range with spectral resolution of $2cm^{-1}$.

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2.2 Reagents

All reagents were of analytical grade and were used without further purification. Deionized water (milipore) was used for solution preparation. Pyrrole-2 carboxaldehyde (PCL), Sodium Dodecyl Sulphate (SDS), Polyvinyl Alcohol (PVA) and other chemicals were purchased from Sigma-Aldrich.

2.3 Procedure

2.3.1 Synthesis ofPolymer thin film doped with PCL and SDS:
In the synthesis of polymer film we weighed 1 gm of PVA polymer, 0.02g of PCL and 0.02g of SDS and mixed themwith 30 ml of deionized water . Keep the solution at 80^0C to heat for 2 hrs and after that allow the stirring to take place for 1 hr at room temperature. When the solution become completely transparent i.e PCL and SDS get completely dissolved, remove the solution from the magnetic stirrer and pour it in the petadish and allow the solvent to evaporate. After the complete evaporation Of the solvent the thin film of polymer is formed and cab be removed from the petadish easily.

3.0 Results and Discussion

3.1Characterizations of Thin film polymer:

3.1.1 UV-Vis Spectroscopy:
The absorption spectra of polymer film is shown in figure1we observed that no new peak arises when we compare the spectra of PVA polymer film with that of PVA+PCL. When we add SDS into it then the peak which was arising at 251nm get suppressed and the intensity of the peak at 294nm gets reduced on adding SDS into PCL and PVA which shows the complex formation taking place between PCL and SDS.

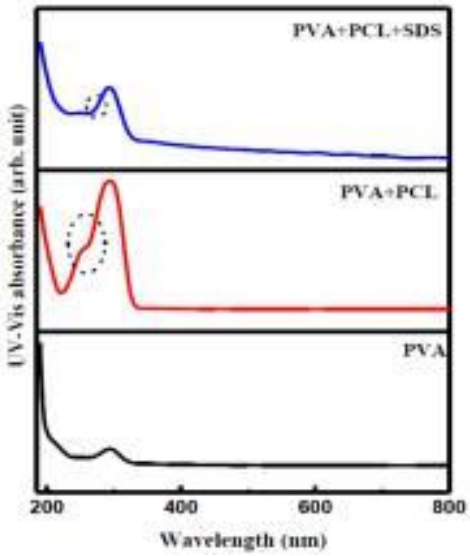

Figure 1. UV-Vis Absorption spectra of PVA, PVA+PCL and PVA+PCL+SDS.

3.1.2 FTIR Spectroscopy: The FTIR spectra of polymer film is shown in figure 2. We saw clear changes occurring in the case of PVA and its comparison with PVA+PCL+SDS polymer film. Several new peaks arised at 1091 cm^{-1},1334 cm^{-1},1432 cm^{-1},2356 cm^{-1} and3330 cm^{-1}.There were no changes observed in the peaks when comparison between IR Spectra of PVA and PVA+PCL polymer film was done which shows there was no interaction taking place between polymer PVA and PCL. PVA polymer can be used to hold the micelle formation between PCL and SDS.

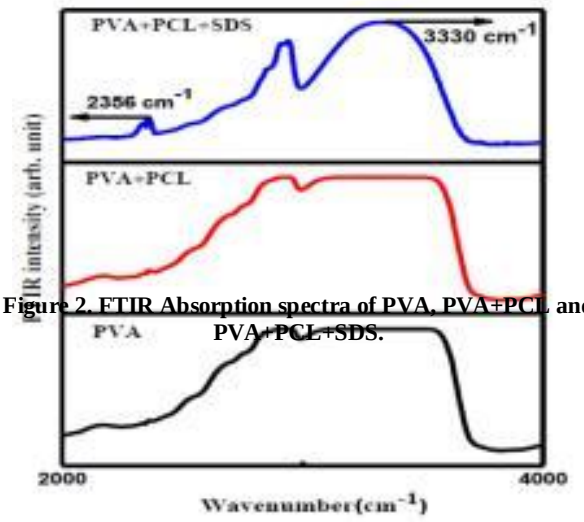

Figure 2. FTIR Absorption spectra of PVA, PVA+PCL and PVA+PCL+SDS.

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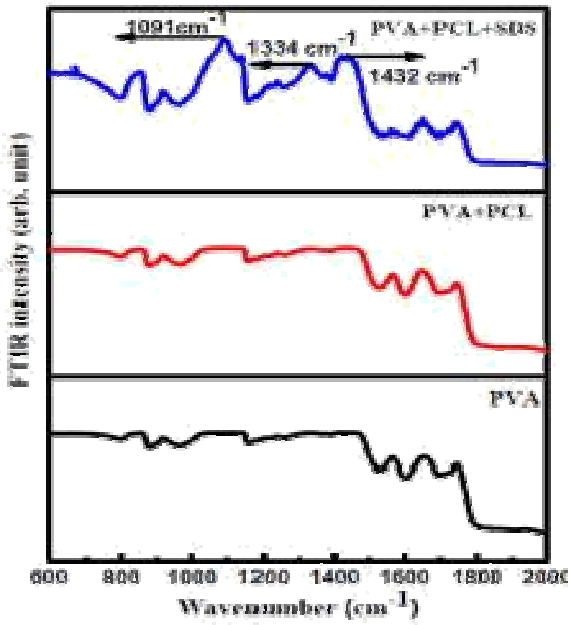

Figure 3. FTIR Absorption spectra of PVA, PVA+PCL and PVA+PCL+SDS.

3.1.3 Fluorescence Spectroscopy: In PVA there were no such changes observed only there was a suppression in the intensity of the peak occurring at 421nm on addition of PCL and SDS into PVA polymer. The results of luminescence show that there is interaction of PCL molecule with the micellar cavity. Depending on the nature of micelle that means depending on the polarity of micelle the nature of the interaction is different.

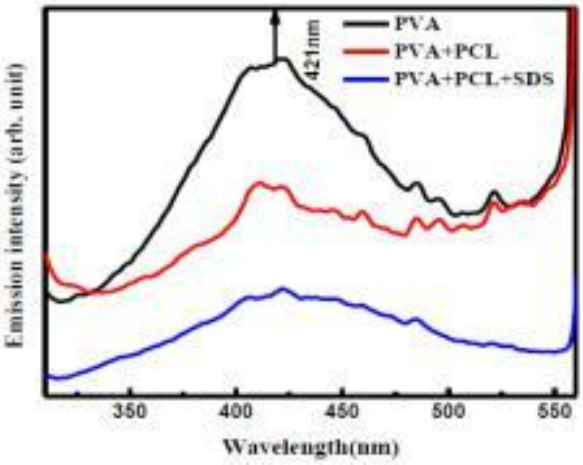

Figure 4. Emission spectra of PVA, PVA+PCL, PVA+PCL+SDS.

4. Conclusion:

Polymer films of PVA, PCL and SDS were synthesized using acetonitrile as a solvent at room temperature through a simple and straightforward process. The Polymer films were characterized using UV–Vis spectroscopy, FTIR spectroscopy and Fluorescence spectroscopy . It is clearly visible that the micellar formation occurs between the PCL and surfactant, SDS above certain critical micellar concentration (CMC) value and polymer can be used to hold the micellar formation to be used in several applications in medical and optoelectronic industry.

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