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Synthesis, characterization of PEDOT nanofiber and electrochemical sensing property of Resorcinol

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Abstract: Poly(3,4 Ethylenedioxythiophene)(PEDOT) nanoparticles were synthesized by chemical oxidative polymerization method.. The PEDOT nanofibers were characterized by UV-Visible, FT-IR, and FE-SEM. The UV-Vis spectrum of PEDOT nanofiber shows π - π^* transitions. The electrochemical sensing properties of the nanoparticles towards resorcinol were studied.

Keywords: Poly(3,4 Ethylenedioxythiophene); nanofibre; electrocatalyst; resorcinol.

1. Introduction and Experimental.

Poly(3,4 ethylenedioxythiophene)(PEDOT) is the successful and Well-known π - conjugated polymers with good conducting and LED properties[1]. This electrically conjugated conducting polymers is used for biosensing application [2]. For the purpose of creating a biosensors based on PEDOT, it is important to develop a synthetic route that can provide the possibility of synthesis of PEDOT by an appropriate biological and chemically oxidative methods[3]. The chemically oxidative polymerization was used to prepare the conducting polymers because of easy procedure and high yield of the product. We have reported the chemical oxidation method to synthesis PEDOT nanofibers and it is characterized using FT-IR, UV-Visible spectrometer, FE-SEM and electrochemical sensing properties of by CV(cyclic voltammetry).

3,4-ethylenedioxythiophene (EDOT), and (1S)(+)-10-Camphorsulfonic acid were purchased from Aldrich. Ammonium persulfate (APS) was purchased from SRL.

EDOT(10mM) and (1S)(+)-10-Camphorsulfonic acid 5mM, were dissolved in Milli Q water(100mL). To this ammonium persulfate (10mM) in 50ml Milli Q water was added dropwise under stirring. The reaction mixture was allowed to magnetic stirring for 12hours and under the ice cooling conditions. After that, the product was centrifuged and washed with ethanol and distilled water (25:75) to remove any unreacted EDOT and ammonium persulfate.

FT-IR spectrum of the PEDOT nanofibers was recorded on PerkinElmer FT-IR 8300. UV-Visible spectrum was recorded using a PerkinElmer 320 spectrophotometer. The morphology of the PEDOT nanofibers was analyzed by HITACHI SU6600 field emission-scanning electron microscopy. The electrochemical experiments were performed on a CHI 1103A electrochemical instrument using the as-modified electrode and bare glassy carbon electrode (GCE) as working electrode, a platinum wire for counter electrode, and saturated calomel electrode (SCE) was the reference electrode.

2. Results and Discussion

The UV-Visible spectrum of poly(3,4 ethylenedioxythiophene) nanofibers was shown in Fig.-1. The maximum absorbance at about 360 nm, a shoulder above 550nm, and broad absorbance in the NIR region are observed. The peak at 580nm ascribed to π - π^* transition of doped PEDOT. In addition, absorbance maximum around 950nm was seen. According to Inganas this absorption corresponds to excitation of polaron structure[4].

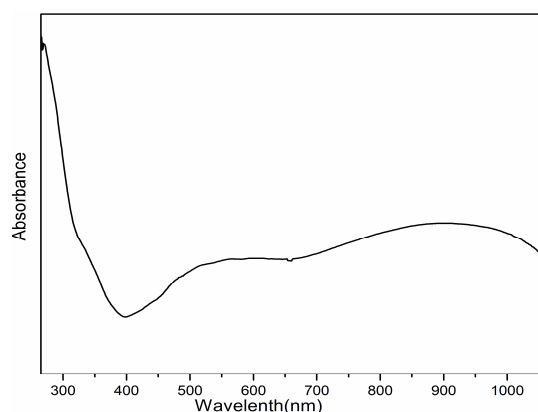


Fig-1. UV-Visible spectrum of PEDOT.

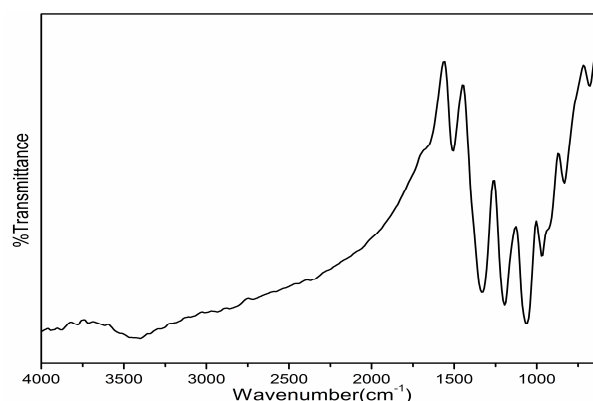


Fig-2. FT-IR spectrum of PEDOT

FT-IR Spectrum of the chemically synthesized PEDOT is shown in Fig. 2. The bands at 1195, 1139, and 1089 cm^{-1} are due to the C-O-O bond stretch in the ethylenedioxy group. The peak at 1521 cm^{-1} is due to the ring stretching of the thiophene ring. The weak vibration at 1062 cm^{-1} is possibly due to the C-O stretch. Peaks at 979, 937, and 840 cm^{-1} are assigned to thiophene C-S bond stretching [5].

Field emission scanning electron microscopy (FE-SEM) is shown in Fig. 3. The PEDOT has nanofiber like morphology. The length and breadth of the PEDOT nanofibres is in the range of several μm and 50-90 nm respectively.

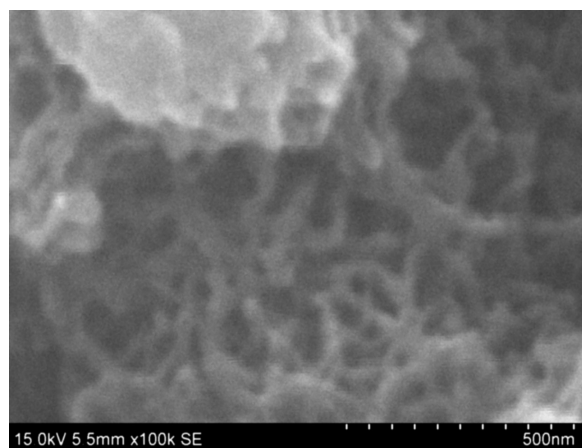


Fig-3. FE-SEM morphology of PEDOT.

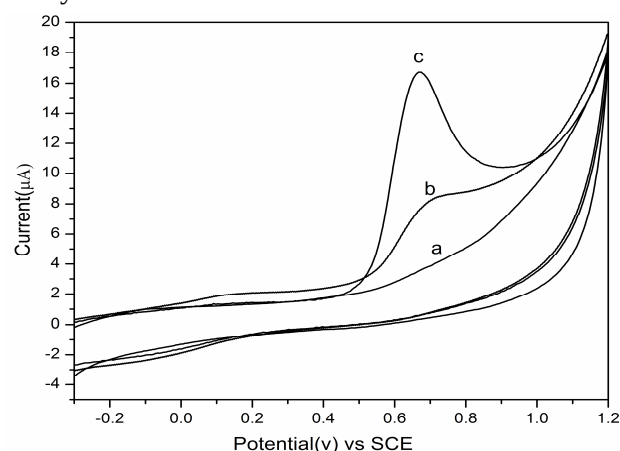


Fig-4. CV a-PBS, b- bare GCE
c-PEDOT/GCE in 0.1 mM Resorcinol .

Electrochemical sensing properties.

Fig. 4 shows cyclic voltammetry of PEDOT nanofiber film as the electrode was cycled in pH solution at a scan rate of 50 mVs^{-1} . When the PEDOT nanofiber film was cycled in pH 7 in PBS buffer solution (sodium phosphate and disodium hydrogen phosphate) the oxidation peak was observed at 0.640 V.

The electrooxidation of 0.1mM resorcinol at (PEDOT/GCE) in (pH 7) is shown in Fig.4C. Generally, bare GCE shows a broad oxidation peak at +0.7 V. However, the PEDOT /GCE shows an oxidation peak at +0.7 V with higher current response (17.5.µA). Hence it is clear that the oxidation of resorcinol at the PEDOT /GCE has enhanced current response than the bare GCE, indicating the electrocatalytic ability of the PEDOT modified electrode. This enhanced electrocatalytic ability is attributed to the larger available surface [6], and variable oxidation state of the polymer.

3. Conclusions

PEDOT nanofibres were prepared by chemical polymerization method. The FTIR, and UV-Visible spectrum confirm the formation of PEDOT nanofibres. SEM image shows that the formation of PEDOT nanofibres. At pH 7.4, 0.1 M PBS, PEDOT exhibits good electrocatalytic activity for the oxidation of recorcinol. The modified electrode prepared is very stable and can be utilized for the determination of recorcinol.

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