Heterophase Polymerization of Pyrrole and Thienyl End Capped Ethoxylated Nonyl Phenol by Iron (III) Chloride

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**Problem Description**

Polypyrrole (PPy) is one of the most investigated conducting polymers, due to its easy synthesis and good conductivity.

However synthetically conductive PPy is insoluble and infusible which restricts its processing and applications. PPy is a hard, brittle, and nonprocessable solid that is insoluble in common solvents.

Since polypyrrole (PPy) homopolymers have some difficulties in the applications, soluble and conductive copolymers of PPy may overcome this difficulties and open new application areas.

This study presents synthesis of novel block copolymers of thienyl end capped ethoxylated nonyl phenol and pyrrole via chemical oxidative polymerization. ENP-ThC served both as a macromonomer and an emulsifier for pyrrole with poor solubility in water.
Experimental

*Synthesis of Ethoxylated Nonyl Phenol-Thiophene Carbonyl Compound (ENP30-ThC)*

\[
C_{9}H_{19}O\left(\text{CH}_{2}\text{CH}_{2}O\right)_{30}H + \text{Th-CCl} \rightarrow \text{ENP-ThC}
\]

Ethoxylated nonyl phenol (ENP)

\[\text{Th-CCl}\]

\[\text{CHCl}_{3}\ 0^\circ\text{C}\ 20\text{ h}\]

ENP-ThC
Experimental

Preparation of Thienyl End-capped Ethoxylated Nonyl Phenol-b-Polypyrrole Copolymer

\[
\text{C}_{9}\text{H}_{19}-\text{O} \left(\text{CH}_2\text{CH}_2\text{O}\right)_{30} \text{C} - \text{O} \ \text{C}_{9}\text{H}_{19}-\text{O} \left(\text{CH}_2\text{CH}_2\text{O}\right)_{30} \text{C} - \text{O} + \text{n} \ \text{Py} \rightarrow \text{ENP-ThC-b-PPy} + \text{Fe}^{+2}
\]
## Results

Reaction parameters
1) The effect of oxidant types and dopant
2) The effect of Thiophenecarbonyl group
3) The effect of molar ratio

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<th>Polymer</th>
<th>Ox</th>
<th>n_{Py}/n_{ENP}</th>
<th>n_{Ox}/n_{Py}</th>
<th>[PTSA]</th>
<th>Yield (%)</th>
<th>σ (S/cm)</th>
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</table>
Results

FTIR results of ENP30-ThC-b-PPy copolymer
Results

Blank PPy

ENP30ThC-b-PPy
Conclusion

• After copolymerization reaction, the particle size of Polypyrrole (PPy) was decreased from 1 nm to 0.4 nm, by means of ENP30ThC addition, as expected. So, the non-processability problem of PPy can be solved by this way.

• Adding thienyl group has increased the oxidative potential of polymer, and this provides an increase in conductivity.

• Also, the molar ratio of Pyrrole to ENP group \( \frac{n_{\text{Py}}}{n_{\text{ENP}}} \) had important effect on the conductivity and yield. As this ratio increases, the conductivity and yield also increases.

• P-toluene sulfonic acid (PTSA) was used to increase the conductivity. As expected, with PTSA, PPy had 40 times higher conductivity than that which had no dopant.
THANK YOU FOR YOUR ATTENTION