Synthesis, characterization and iodide ions sensing of a new 1,5-naphthyridine-containg conjugated polymer

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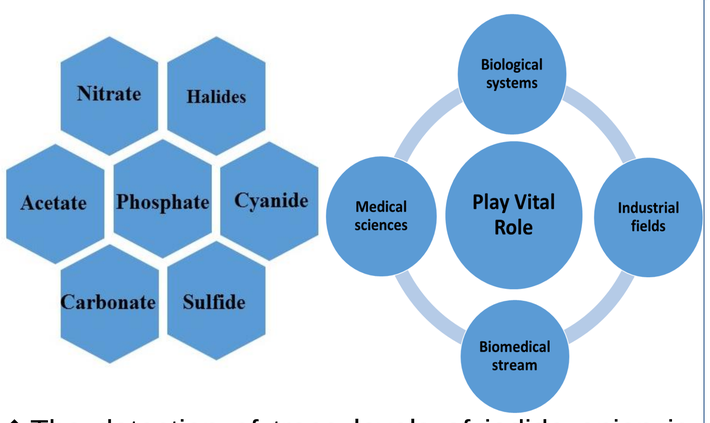
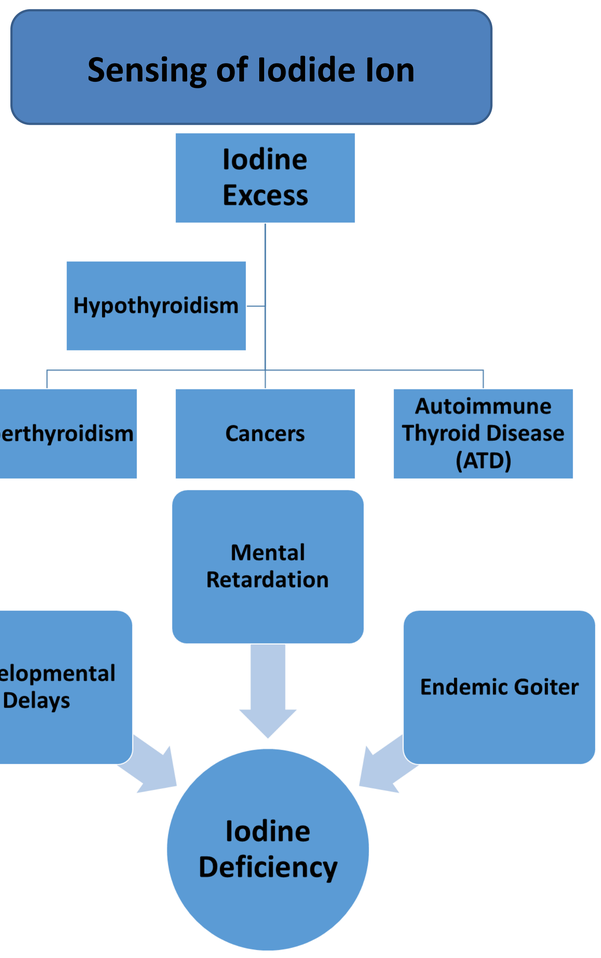
Abstract

A new conjugated copolymer poly(2-(2-methoxyphenoxy)-6-(3-methoxyphenoxy)-1,5-naphthyridine)-p-bisdodecyloxyphenylene vinylene) (**P1**) was prepared by the Horner-Emmons polymerization reaction. **P1** bears excellent solubility in most organic solvents which warrants its suitability for photovoltaic devices application. **P1** is selective iodide anion sensor over a wide range of other anions (F^-, Cl^-, Br^-, NO_3^-, CN^-). The initial colorless solution of **P1** changed to deep yellow upon the addition of aqueous solution of iodide salts along with significant changes in the UV-vis spectra. **P1** was characterized by ^{1}H-NMR, FT-IR, and diffuse reflectance UV-vis spectroscopy (DR UV-vis).

Introduction



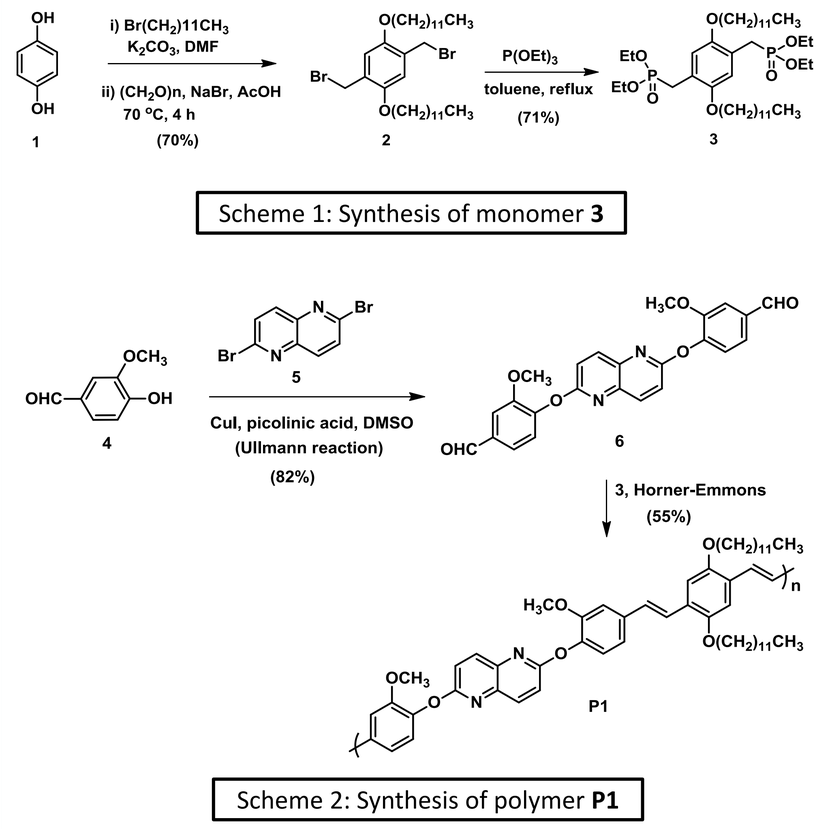
- The detection of trace levels of iodide anion is highly desirable since iodine is essential for normal human growth and plays important role in thyroid gland function.



Objective

- Synthesis of a new phenylene vinylenes copolymers.
- Characterization by ^{1}H-NMR and ^{13}C-NMR.
- Colorimetric sensing of iodide ions.

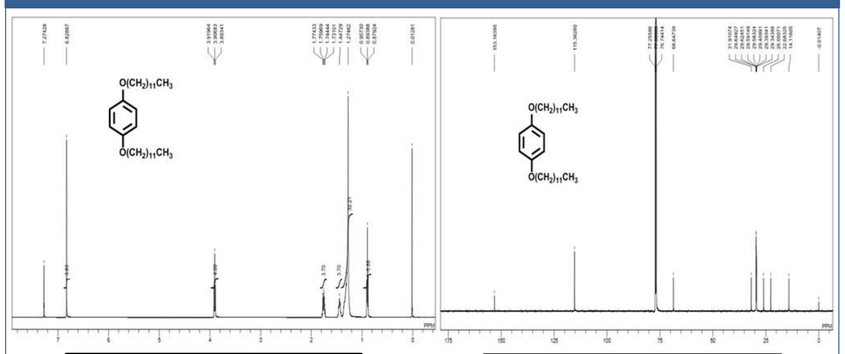
Methods and Materials



Scheme 1: Synthesis of monomer **3**

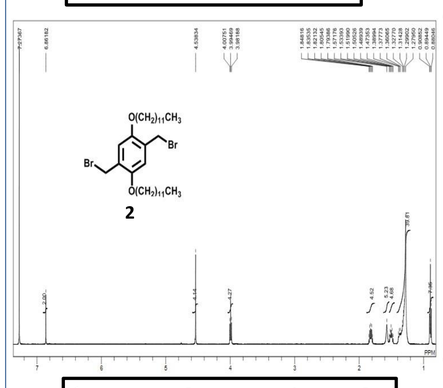
Scheme 2: Synthesis of polymer **P1**

Characterizations

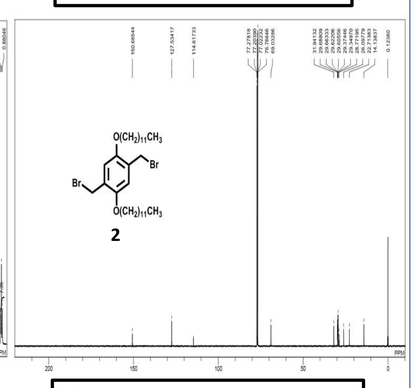


^{1}H-NMR of intermediate

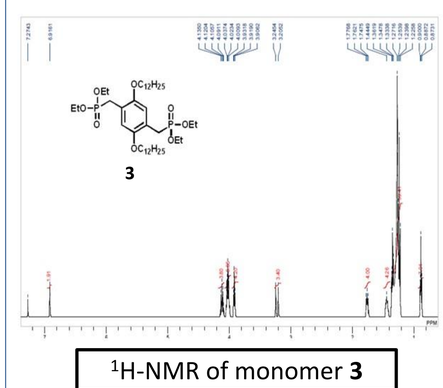
^{13}C-NMR of intermediate



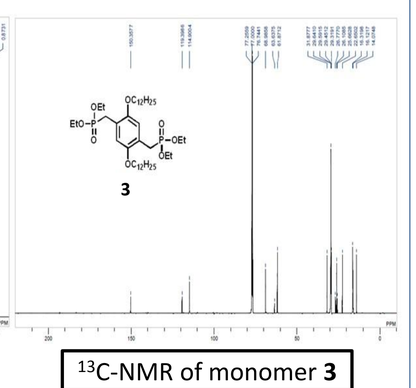
^{1}H-NMR of intermediate of **2**



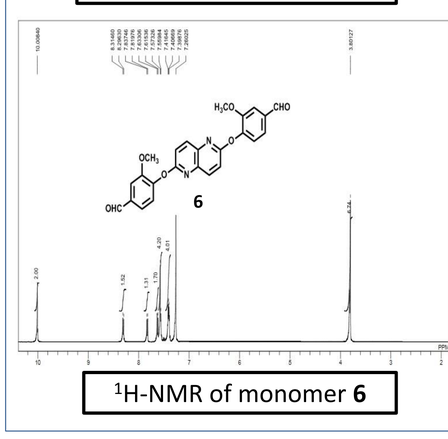
^{13}C-NMR of intermediate **2**



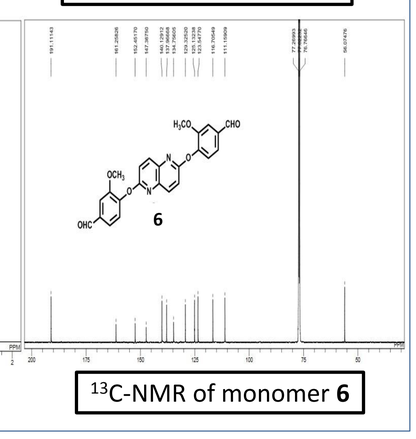
^{1}H-NMR of monomer **3**



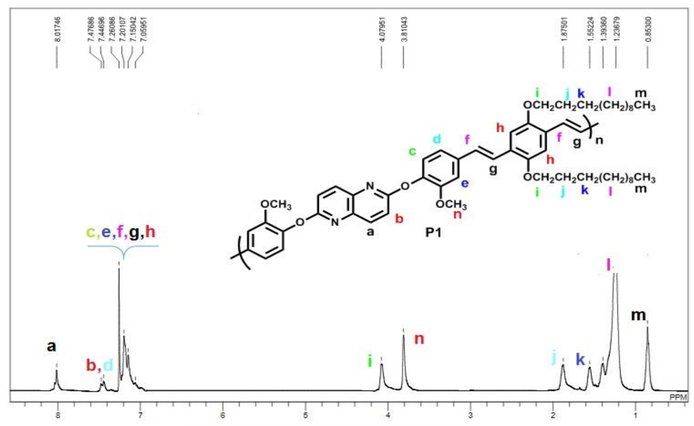
^{13}C-NMR of monomer **3**



^{1}H-NMR of monomer **6**

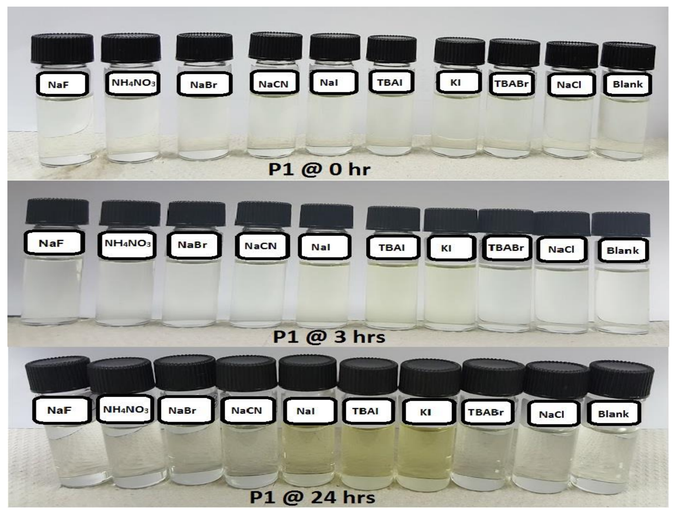


^{13}C-NMR of monomer **6**



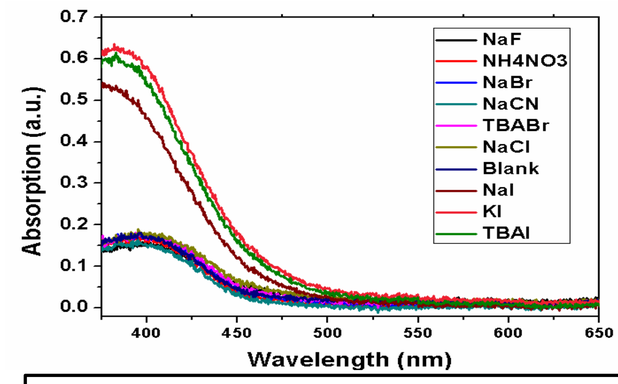
^{1}H-NMR of polymer P1

Iodide sensing

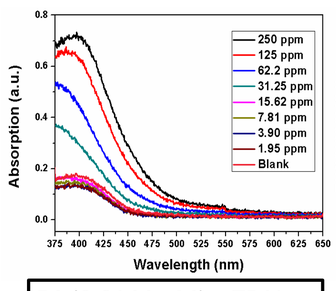


Color changes of **P1** upon addition of Br^- (NaBr, TBABr), Cl^- (NaCl), F^- (NaF), I^- (TBAI, NAI, KI), NO_3^- (NH_4NO_3) and CN^- (NaCN). Concentrations of **P1** and anions are 0.0144 μM and 250 ppm, respectively (**Table 1**)

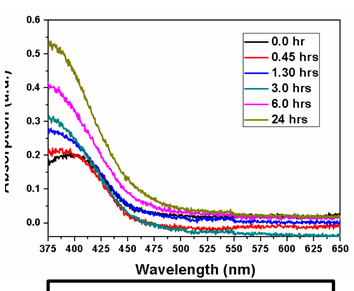
Salt Solutions	P1					
	0.0 hrs	0.45 hrs	1.30 hrs	3.0 hrs	6 hrs	24 hrs
TBAI	-	+	+	++	++	+++
NaI	-	+	+	++	++	+++
KI	-	+	+	++	++	+++
NaF	-	-	-	-	-	-
NH_4NO_3	-	-	-	-	-	-
NaCl	-	-	-	-	-	-
NaBr	-	-	-	-	-	-
NaCN	-	-	-	-	-	-
TBABr	-	-	-	-	-	-



P1 (0.0144 μM) + different anions (250 ppm) after 24 hrs.



P1 (0.0144 μM) + TBAI (250-1.95 mM) at 24 hrs



P1 (0.0144 μM) + TBAI (31.25 ppm) at 0-24 hrs

Conclusions

- Synthesis and characterization of **P1**.
- **P1** is selective iodide anion sensor.
- Colorimetric detection limit of 31.25 ppm.
- **P1** has excellent solubility in organic solvents and thus could be used for photovoltaic applications.

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