Polymer gel electrolyte with poly(hydroxymethyl EDOT)-urethane suparmolecular network

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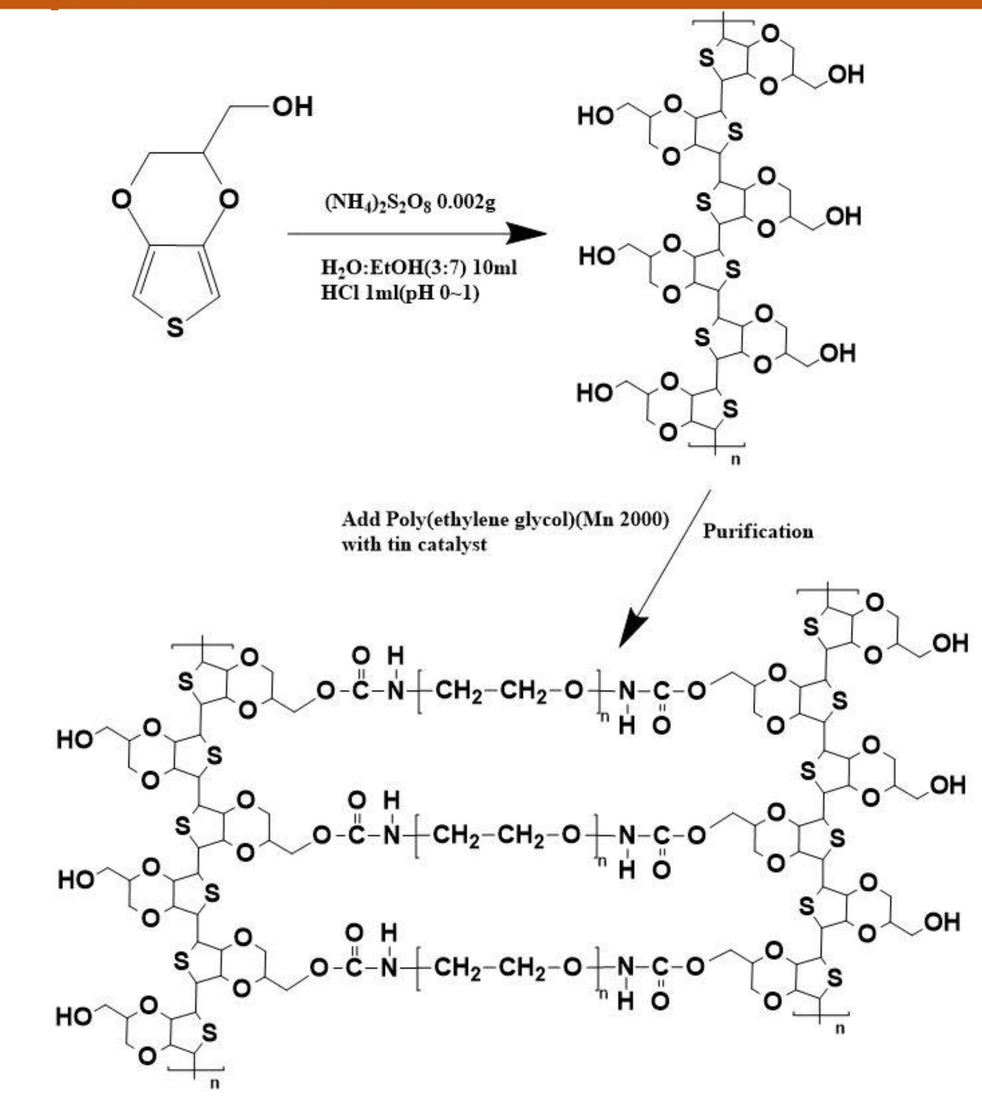
Abstract

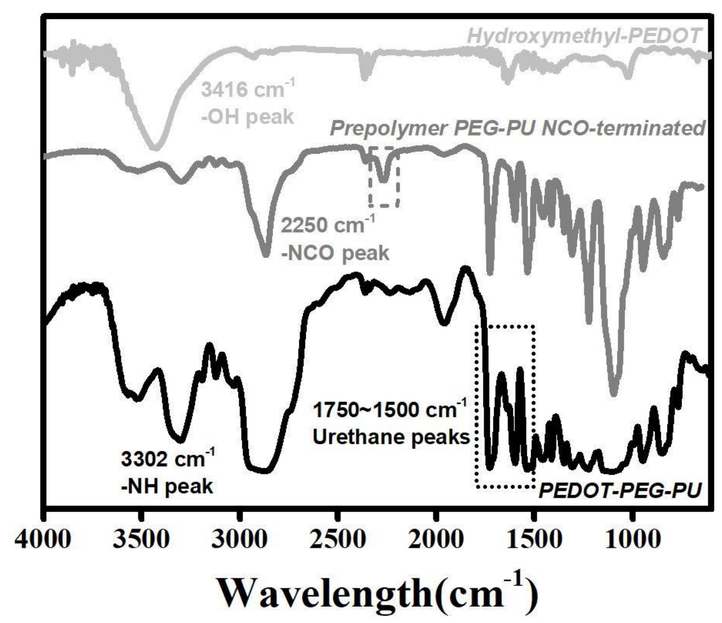
Gel polymer electrolyte chemically bonded to a π-conjugated polymer was synthesized by graft copolymerization of MDI-terminated poly (hydroxymethyl EDOT) (MDI-PEDOT) and poly (ethylene glycol) (PEG) as a designed ladder-type structure. The successful formation of supramolecular network has been confirmed by analyzing Fourier transform infrared spectroscopy (FT-IR). A series of polyurethane (PU)-PEDOT and $LiClO_4$ based polymer gel electrolytes were prepared with different of [O/Li^+] ratios. The pH effect of optical change and electrical capacitance was investigated by UV–vis–NIR absorption spectroscopy and cyclic voltammetry. The ionic conductivities of PU-PEDOT/Li^+ complexes at a fixed pH were also evaluated using impedance analysis based on a function of $LiClO_4$ concentration.

Experiment



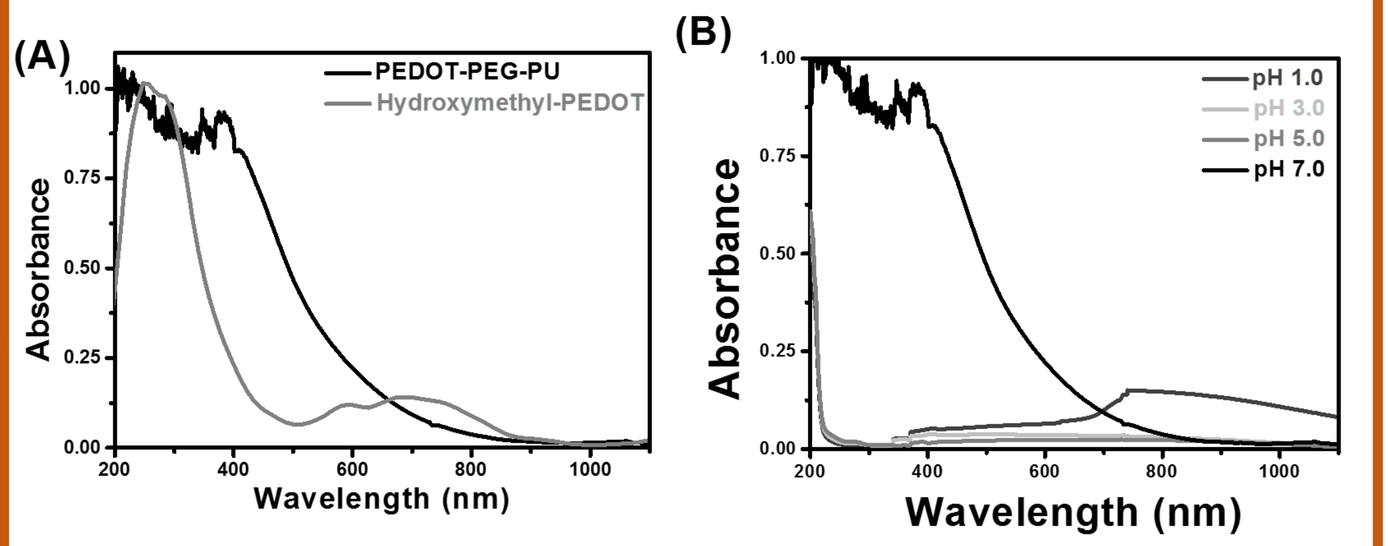
Supramolcular structure by Urethane crosslinkage

FT-IR

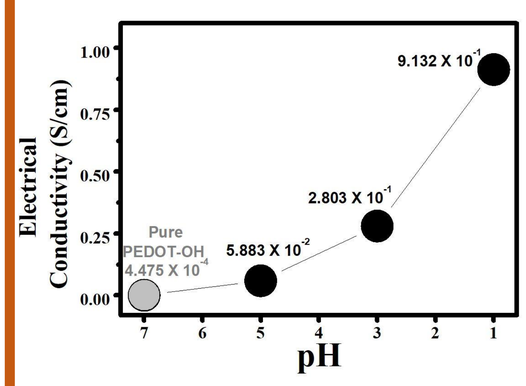


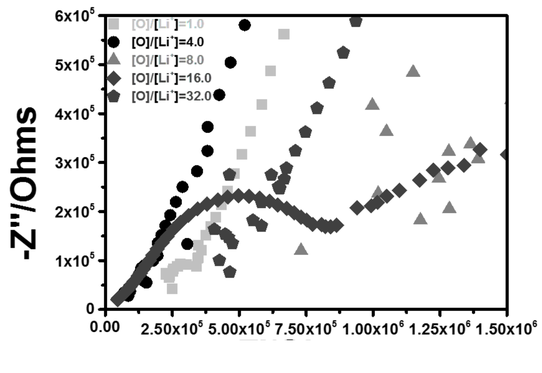
Functional group	Wave Number
$-NH_2$	3300
-CO	2880
-OH	3410
-NCO	2250

UV



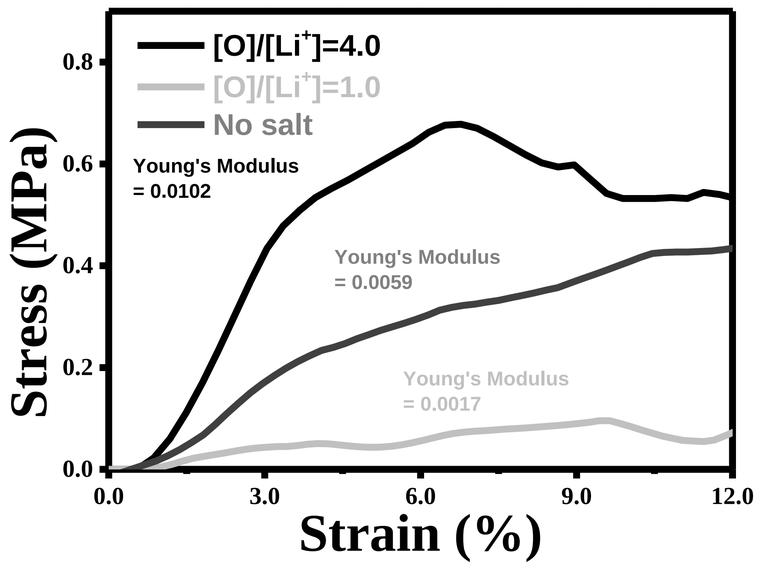
Electro & Ionic Conductivity





Ratio [O]/[Li^+]	Thickness (cm)	Surface (cm^2)	Bulk resistance (Ω)	Ionic conductivity (S/cm)
1.0			3.404×10^5	1.974×10^{-6}
4.0			1.947×10^5	3.451×10^{-6}
8.0	0.168	0.25	7.310×10^5	9.193×10^{-7}
16.0			8.416×10^5	7.985×10^{-7}
32.0			1.671×10^5	4.022×10^{-9}

UTM-Pull to Break



Salt ratio [O]/[Li+]	Youngs Modulus
4.0	0.0102
1.0	0.0059
No salt	0.0017

Conclusion

1. A PEDOT-PEG-PU supramolecular network with a ladder-structure was synthesized using the covalent bonding of π-conjugated PEDOT as a frame and PEG-PU as a rung.
2. The maximum ionic conductivity of PEDOT-PEG-PU/Li^+ supramolecular complex is observed at a molar ratio of [O]/[Li^+] = 4.0 and exhibits the ionic conductivity of 3.451×10^{-6} S/cm.
3. A PEDOT-PEG-PU/Li^+ supramolecular complex would be expected to have sufficiently potential applications as a conducting medium of efficient performance devices for energy conversion, energy storage, and clean energy.

Acknowledgment

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