바이오센서를 위한 수용성 고분자의 합성과 응용

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Synthesis and Application of Water-Soluble Polymer for Biosensor

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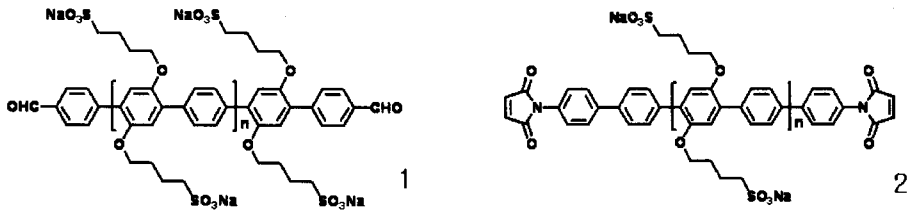
1. Introduction

In recent years, application of fluorescent conjugated polymers to sense chemical and biological analytes has received much attention for many researcher. Water-soluble conjugated polymers are being increasingly studied for biosensor because of their detection applications, such as DNA, proteins, and biological agents. We have attempted to synthesize water-soluble poly(para-phenylene) derivatives, such as poly[2,5-bis(3-sulfonatobutoxy)-1,4-phenylene-alt-1,4-phenylene]sodium salt and poly[2,5-bis(6-N,N,N-triethylammonium-1-oxapropyl)-1,4-phenylene-alt-1,4-phenylene]dibromide.

2. Results and discussion

Polymers were prepared via the Suzuki coupling reaction between dibromo monomer and diboronic acid monomer Scheme 1.

We developed a method to introduce a benzaldehyde and 4-(bromophenyl)-maleimide group, a versatile functional group for bioconjugation, at both ends of PPPs chain.



Scheme 1. Synthesis of polymers 1, 2

Due to the presence of the sulfonate side chains in the polymers, synthesized conjugated polymers showed good solubility in water. The UV-vis spectrum of polymers shows its absorption

maximum at 340 nm in aqueous solution. The emission maximum of the photoluminescence spectrum was observed at 416 nm in aqueous solution Figure 1.

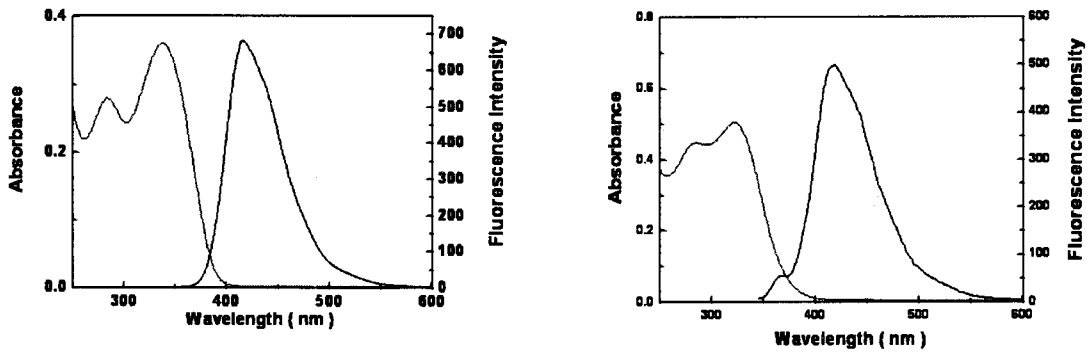


Figure 1. UV-vis and photoluminescence spectra of polymers 1 and 2 in aqueous solution [Polymer 1] = $1.92X10^{-5}$ M, [Polymer 2] = $5.96X10^{-5}$ M

We studied FRET(fluorescence resonance energy transfer) effect using our conjugated polymers 1 and 2 for ultimate applications such as DNA, RNA, protein sensor. The emission spectrum of polymers 1 and 2 in water overlaps the absorption spectrum of fluorescein sodium salt. The FRET should be expected between these molecules Figure 2.

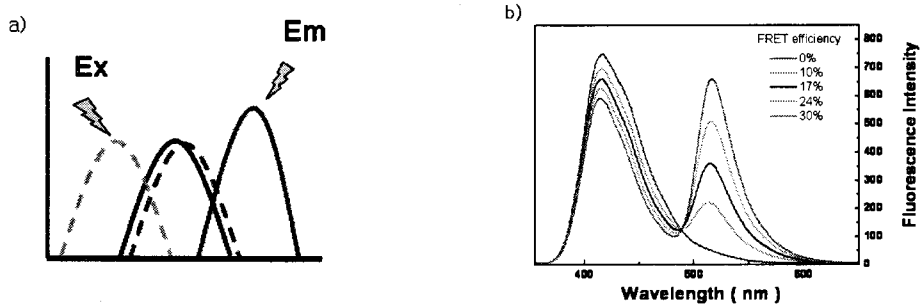


Figure 2. a) FRET mechanism b) FRET efficiency of polymer 1

3. Conclusions

We synthesized water-soluble PPPs with the sulfonate side chains. The polymers showed good solubility in water. FRET was accomplished successfully by combination of polymer 1 and fluorescein to exhibit green fluorescence.

References

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