

# Synthesis and Characterization of a Donor-Acceptor Copolymer for Optoelectronic Devices

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## Introduction

In the growing field of organic electronic several types of polymer systems and device architectures have shown great potential to improve the performance and chemical stability for optoelectronic devices. The development of new structures, in general copolymers, use the concept of molecular engineering to perform the reduction of the band gap and, at the same time, to modulate HOMO-LUMO energy levels to optimal values, both fundamental requirements for optoelectronic applications. In particular, copolymers formed by alternated donor and acceptor segments (D-A type) are attractive<sup>1</sup>. These polymers are designed in such a way that it can facilitate internal charge transfer phenomena (ICT), resulting in an electron-rich unit and an electron-deficient moiety within the repeating unit<sup>2</sup>. This ICT intrinsic gives a strong double-bond characteristic between repeating units, allowing a more planar configuration that facilitates the  $\pi$ -electron delocalization.

## Results and Discussion

The Poly[9,9-bis(3'-(tert-butyl propanoate))fluorene-co-4,7-(2,1,3-benzoselenadiazole)], PFeBSe, a donor-acceptor copolymer, was synthesized through the Suzuki route (Figure 1).

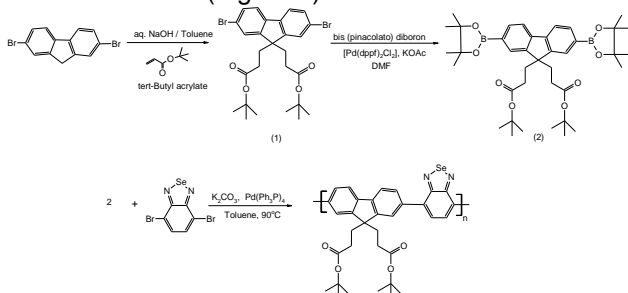


Figure 1. Chemical route for synthesis of PFeBSe.

The copolymer was characterized by <sup>1</sup>H-NMR, gel permeation chromatography (GPC), cyclic voltammetry, UV-Vis and photoluminescence spectroscopy.

The molar mass (Mn) of PFeBSe was 37000 g mol<sup>-1</sup> (PDI= 2.50). The polymer showed good solubility in organic solvents and formed homogeneous, self-supporting films by casting from solutions.

Figure 2 shows the optical electronic absorption and the emission spectra of PFeBSe in CHCl<sub>3</sub> solution (10<sup>-5</sup> mol L<sup>-1</sup>). The absorption spectrum displays two absorption maxima located at  $\lambda_{max} = 341$  and 480 nm. The photoluminescence (PL) spectrum shows a peak centered at  $\lambda_{em} = 569$  nm, independently of the excitation energy. The spectral shape with a “camel back” character<sup>3</sup> and a single emission process are known to be a signature of the donor-acceptor copolymer structure with an ICT state.

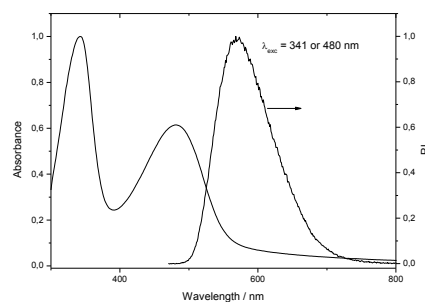


Figure 2. Photoluminescence and electronic absorption spectra of PFeBSe.

The oxidation and reduction potentials of PFeBSe were determined by cyclic voltammetry and the values for the HOMO and LUMO levels were determined as -5.60 and -3.07 eV, respectively.

## Conclusions

The PFeBSe was successfully synthesized via the Suzuki route. The initial photophysical studies have shown that this copolymer has D-A character with intrachain charge transfer processes. Initial studies using this copolymer in PLEDs showed an orange electroluminescence, indicating the possibility of application of this material.

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