Photovoltaic performance of PFTBTT copolymers

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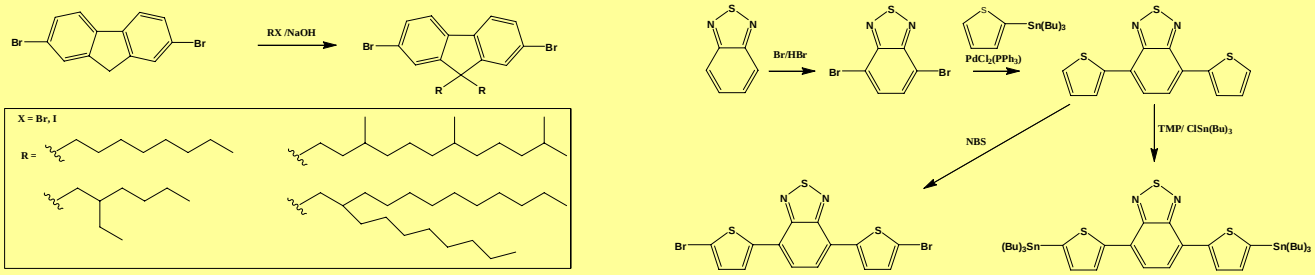
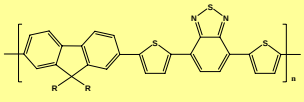
Introduction

Our project aims at the understanding and improvement of the photovoltaic properties of organic solar cells with all-polymer-type, active layers. For an investigation of the influence of increasing electronic disorder on the photovoltaic properties we have synthesized alternating and random fluorene/dithienylbenzothiadiazole copolymers. The copolymers have been characterized by GPC and UV/Vis spectroscopy. First all-polymer solar cells have been prepared and characterized.

Synthesis of the Monomer

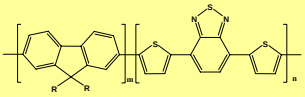


Alternating copolymers via Stille-type coupling



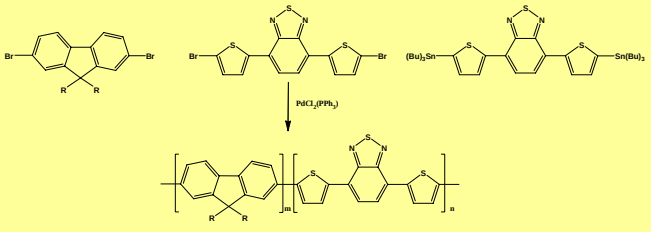
R	M_n g/mol	M_w g/mol	% TBTT
Octyl	5000	12400	44
Ethylhexyl	4000	6000	47
Farnesyl	5000	10000	51

Random copolymers via Yamamoto-type coupling



R	M_n g/mol	M_w g/mol	% TBTT
Ethylhexyl	40000	160000	2,25
Farnesyl	10000	15000	17
Ethylhexyl	10000	20000	32

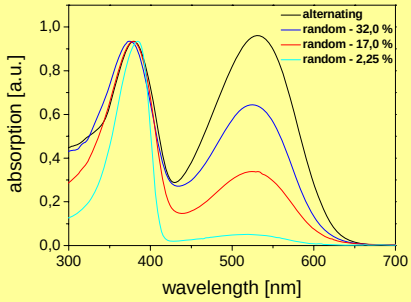
Partially alternating copolymer via Stille-type coupling



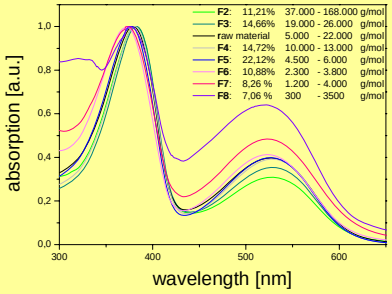
R	M_n g/mol	M_w g/mol	% TBTT
Octyl	2000	3500	44
Farnesyl	4500	9000	40

Optical properties of the copolymers PFTBTT

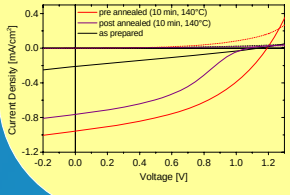
Optical properties of alternating and random copolymers



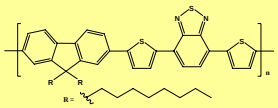
Fractionation of one random PFOTBTT copolymer by preparative GPC



Performance of all-polymer bilayer solar cells based on alternating PFOTBTT on top of 3nm P3HT interlayer



sample	FF [%]	V_{OC} [V]	J_{SC} [mA/cm²]	PCE [%]
pre annealed	43.6	1.2	1.0	0.5
post annealed	38.8	1.1	0.8	0.3
as prepared	27.3	1.1	0.2	0.06



Conclusion

- Alternating, random and partially alternating fluoren bisthienylbenzothiadiazole (TBTT) copolymers with M_n up to 40000 have been prepared
- The UV/Vis spectra exhibit two characteristic absorption bands for the fluoren (300 – 400 nm) and TBTT building blocks (450 – 600 nm)
- Fractionation of one random copolymer (R = octyl) by preparative GPC was carried out and showed different UV/Vis Spectra for different molecular weights thus indicating a different reactivity of the monomers in the Yamamoto-type coupling
- First solar cell experiments gave maximum efficiency of 0,5% for the alternating copolymer with R = octyl