Poly(*p*-phenylene vinylene): Highlights within the SFB 595

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Project A5

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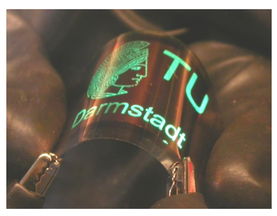
Motivation

The motivation for the investigations in project A5 was the insufficient life-time, color-stability and efficiency of organic light-emitting diodes (OLEDs) based on polymeric semiconductors. Obviously the lack of performance was mainly caused by defects and impurities.
Therefore the intention here was to investigate

- the relevance of constitutional defects and impurities for OLED applications,
- their origin during synthesis,
- a procedure to avoid or at least minimize their amount in resulting polymers.

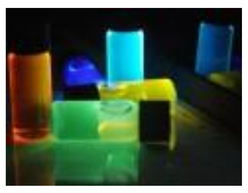


Later on our goal was the development of measures to systematically change emission color of Poly(*p*-phenylene vinylenes) (PPVs) from orange-red towards blue emission.
In this context we were investigating

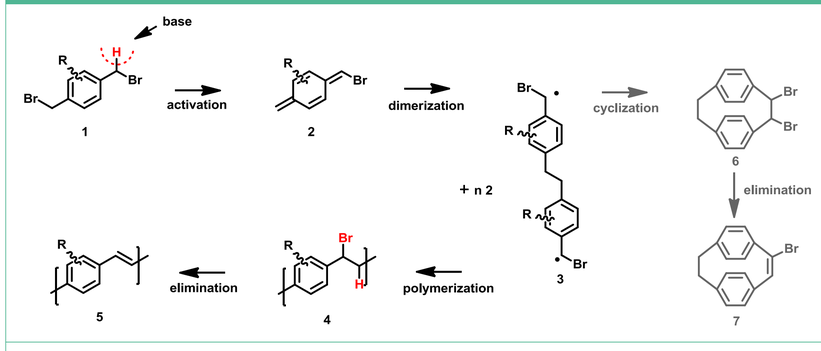
- the influence of a variety of lateral substituents attached at different positions of the polymeric backbone,
- the influence of those substituents on the formation of constitutional defects during synthesis.

In addition we were focusing on the thermal and morphological behavior of PPVs.
To investigate morphological changes we were monitoring

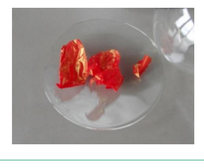
- changes for the glass-transition temperature of the polymers,
- changes in the crystallinity of the polymer-films with help of polarization microscopy.



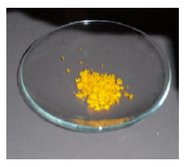
Results

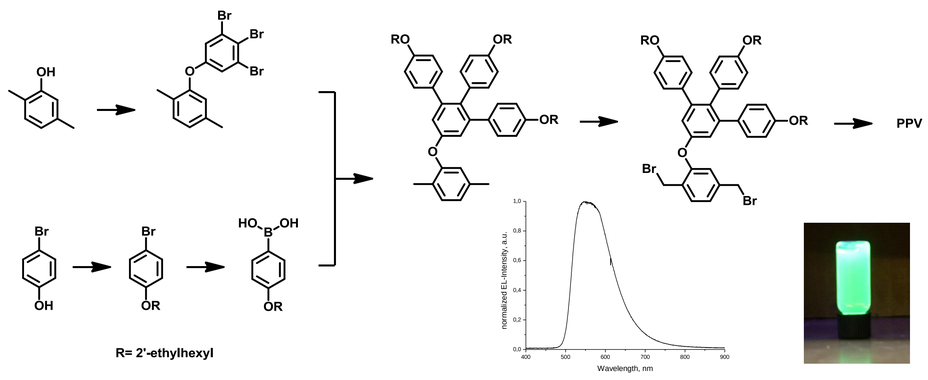


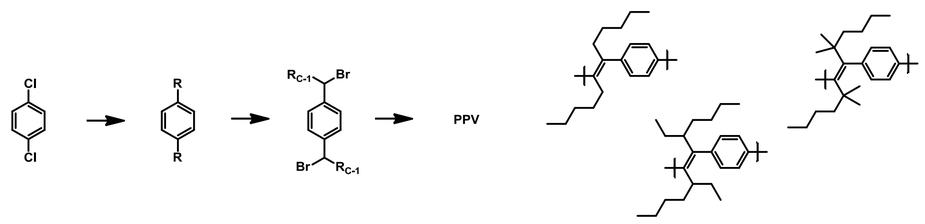
Constitutional defects result from the radical chain growth mechanism of the Gilch polymerization



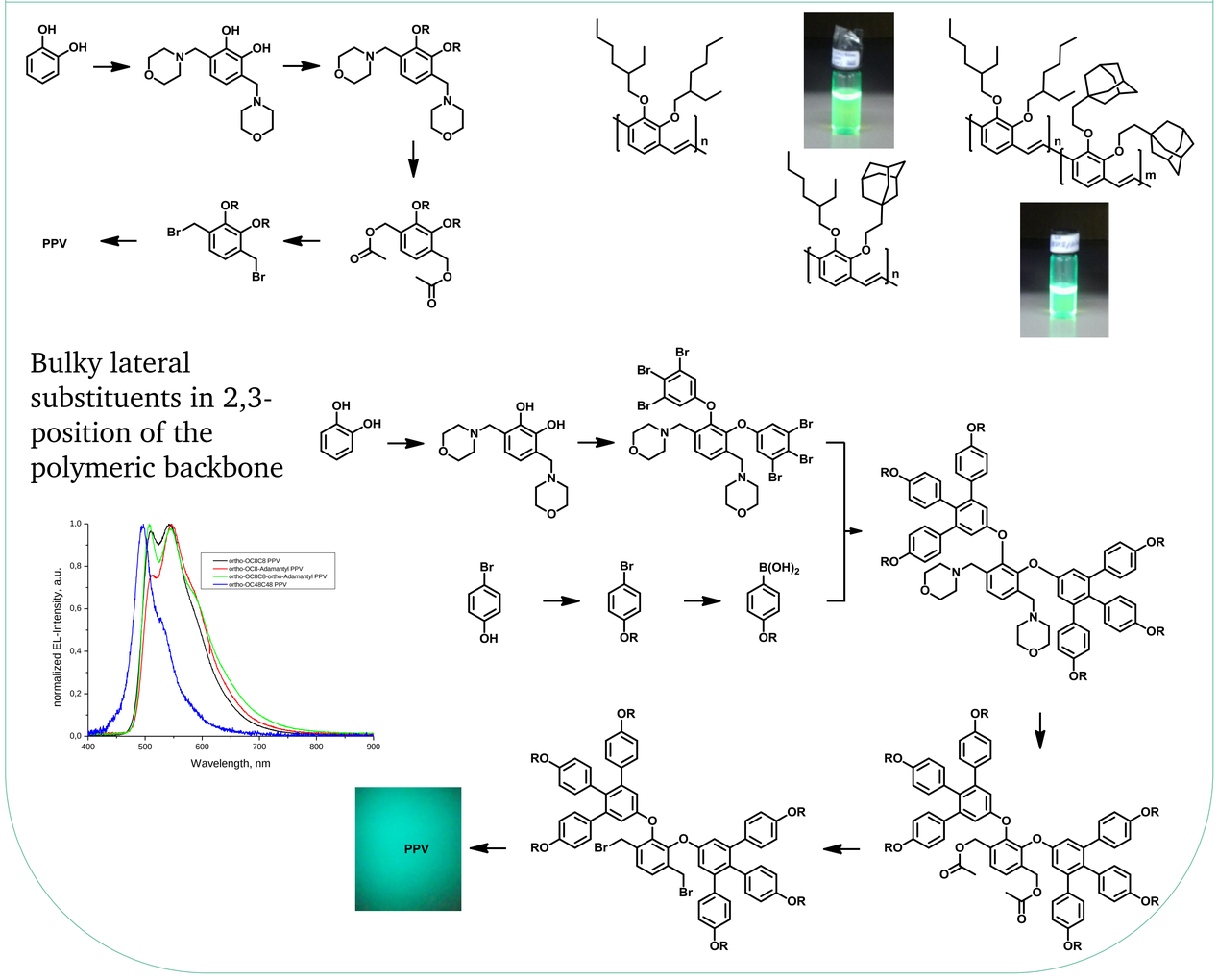
Transfer of the emission center to the lateral substituents







Attachment of lateral substituents at the vinylene double-bonding



Publications last funding period

1) Vilbrandt, N.; Nickel, S.; Immel, S.; Rehahn, M.; Stegmaier, K.; Melzer, C.; v. Seggern, H.; Edts. Schluter, D. A.; Iawaker, C.; Sakamoto, J.: "*Synthesis of Polymers: New Structures and Methods", Chapter 29: „Poly(p-phenylene vinylene)s",* Wiley-VCH, Weinheim, 2012.

2) Vilbrandt, N.; Rehahn, M., "Long-living organic light-emitting-devices based on poly(*p*-phenylene vinylenes)", *PSME Preprint* **2012**, *106*, 185.

3) Vilbrandt, N.; Rehahn, M., "Scope and limits of the Gilch synthesis of poly(*p*-phenylene vinylenes)", *Polymer Preprint* **2012**, *53*, 89.

4) Zhang, F.; Melzer, C.; Gassmann, A.; von Seggern, H.; Schwalm, T.; Gawrisch, C.; Rehahn, M.; "High-performance n-channel thin-film transistors with acene-based semiconductors", *Organic Electronics* **2013**, *14*(3), 888-896.

5) Gassmann, A.; Yampolskii, S. V.; Albe, K; Klein, A.; Vilbrandt, N.; Pekkola, O.; Genenko, Y. A.; von Seggern, H; Rehahn, M., "Study of fatigue by defect engineering in organic light-emitting diodes", *Material Science and Engineering B.* **2014**, submitted.

6) Vilbrandt, N.; Rehahn, M.; Gassmann, A.; v. Seggern, H., „Blue-green emitting poly(*p*-phenylene vinylene) for organic light-emitting diode applications", *Chemistry of Materials* **2014**, in preparation.

5 Key Publications (2003-2014)

1) Vilbrandt, N.; Nickel, S.; Immel, S.; Rehahn, M.; Stegmaier, K.; Melzer, C.; v. Seggern, H.; Edts. Schluter, D. A.; Iawaker, C.; Sakamoto, J.: "*Synthesis of Polymers: New Structures and Methods", Chapter 29: „Poly(p-phenylene vinylene)s",* Wiley-VCH, Weinheim, 2012.

2) Schwalm, T.; Wiesecke, J.; Immel, S.; Rehahn, M., „The Gilch Synthesis of Poly(*p*-phenylene vinylenes): Mechanistic Knowledge in the Service of Advanced Materials", *Macromolecular Rapid Communication* **2009**, *30*, 1295-1322.

3) Schwalm, T.; Rehahn, M., „Efficient Oxygen-Induced Molar-Mass Regulation of Poly(*p*-phenylene vinylenes) synthesized via the Gilch Route", *Macromolecular Rapid Communication* **2008**, *29*, 207-213.

4) Langecker, J.; Rehahn, M., „Iridium-functionalized Polyfluorenes: Advantages and Limitations of the Suzuki and Yamamoto Approaches", *Macromolecular Chemistry and Physics* **2008**, *209*, 258-271.

5) Schwalm, T.; Wiesecke, J.; Immel, S.; Rehahn, M., „Toward Controlled Gilch Synthesis of Poly(*p*-phenylene vinylenes): Anionic vs Radical Chain Propagation, a Mechanistic Reinvestigation", *Macromolecules* **2007**, 40, 8842-8854.