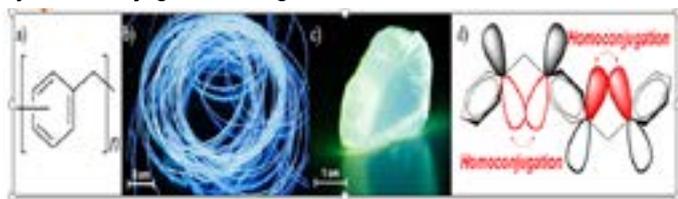


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London, UKA Braendle et al., Polym Sci 2018, Volume 4  
DOI: 10.4172/2471-9935-C2-011**POLY(PHENYLENE METHYLENE): A THERMALLY STABLE, PROCESSABLE  
HYDROCARBON POLYMER WITH UNEXPECTED PHOTOLUMINESCENCE****A Braendle<sup>1</sup>, A Perevedentsev<sup>1</sup>, P Schwendimann<sup>1</sup>, N J Cheetham<sup>2</sup>, P N Stavrinou<sup>3</sup>, J A Schachner<sup>4</sup>, N C Mösch Zanetti<sup>4</sup>, M Niederberger<sup>1</sup> and W R Caseri<sup>1</sup>**<sup>1</sup>ETH Zurich, Switzerland<sup>2</sup>Imperial College London, UK<sup>3</sup>University of Oxford, UK<sup>4</sup>University of Graz, Austria

**P**oly(phenylene methylene) (PPM) lies structurally between linear polyethylene and poly(p-phenylene). It can readily be synthesized in large quantities on laboratory scale (>150 g) and in absence of solvents by catalytic polymerization of benzyl chloride with SnCl<sub>4</sub>. Molar masses up to 61,000 g/mol were achieved, which are an order of magnitude above previously reported values. The polymer can be processed easily into fibres, films and foams. TGA analysis revealed an exceptionally high onset of the decomposition temperature around 470°C. Remarkably, PPM exhibits photoluminescence between 400-600 nm. This phenomenon cannot be caused by  $\pi$ -electron delocalization of alternating double and single bonds. Instead, the results of extended investigations are in line with homoconjugation as the origin of the photoluminescence. Homoconjugation only arises in special chemical structures for which conjugation across individual  $\pi$ -electron systems can occur by overlap of p-orbitals although those systems are separated by an electronically insulating group, e.g. a methylene group. Notably,  $\pi$ -stacking, aggregation/crystallization and impurities were excluded as the origins of fluorescence. PPM also shows a remarkably long photoluminescence lifetime of 8.55 ns (thin film) and a quantum efficiency of 69% (solution). We believe that poly(phenylene methylene) will serve as an example of a new class of fluorescent polymers characterized by homoconjugation along the main chain.



**Figure 1:** a) Chemical structure of PPM. Photographs taken under UV-light (365 nm) illumination of b) drawn fibers and c) bulk PPM. d) Schematic representation of homoconjugation in a chain segment of poly(phenylene methylene).

**Recent Publications**

1. A Braendle et al. (2017) Synthesis and fractionation of poly(phenylene methylene). *J. Polym. Sci: Part A Polym. Chem.* 56(3):309-318.
2. A Braendle et al. (2017) Homoconjugation in poly(phenylene methylene)s: a case study of non  $\pi$  conjugated polymers with unexpected fluorescent properties *J. Polym. Sci: Part B Polym. Phys.* 55(9):707-720.
3. A Braendle et al. (2017) *CHIMIA.* 71:733.
4. H Zhang et al. (2017) Why do simple molecules with "isolated" phenyl rings emit visible light? *J. Am. Chem. Soc.* 139:16264-16272.
5. Q Yan et al. (2016) Three-dimensionally homoconjugated carbon-bridged oligophenylenevinylene for perovskite solar cells. *J. Am. Chem. Soc.* 138(34):10897-10904.

**Biography**

A Braendle holds a MSc in Interdisciplinary Sciences from ETH Zürich with a focus on polymer chemistry and materials sciences. He is currently a PhD candidate in Walter Caseri's research team at ETH Zürich. His research interests include synthesis of hydrocarbon polymers and their optical properties. More specifically, his work examines the synthesis of poly(phenylene methylene)s by Friedel-Crafts-type catalysts and the analysis of its peculiar materials properties with advanced spectroscopic methods.

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