

1.2 Molecular Second-Order Hyperpolarizabilities of Poly (2,5-dialkoxy-p-phenyleneethynylene)s and of Fullerene Derivatives

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In recent years there has been a considerable interest in the photoluminescence and electroluminescence (EL) properties of conjugated polymers. In this context, the poly(2,5-dialkoxy-p-phenyleneethynylene)s (PPE)s (Fig. 2) were investigated for their EL properties by Ch. Weder at MIT.

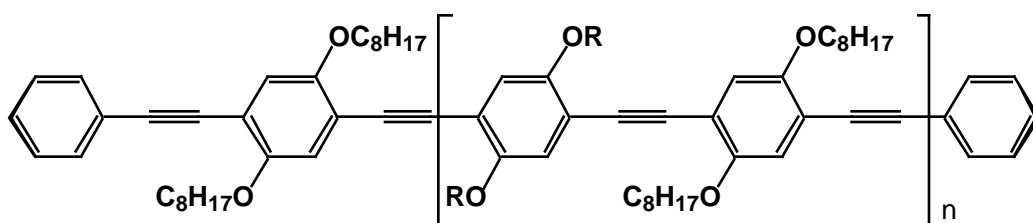


Fig. 2 Molecular structure of the poly(2,5-dialkoxy-p-phenyleneethynylene)s investigated in this work.

In an effort to better understand the relationship between molecular structure and photo-physical properties, we have investigated the third - order nonlinear optical properties of a series of the (PPE)s by third-harmonic generation (THG) experiments in solutions and thin films. For thermally annealed films, values up to $1.4 \cdot 10^{-19} \text{ m}^2/\text{V}^2$ were measured for the third-order nonlinear susceptibility ⁽³⁾. In solution, the susceptibilities ⁽³⁾ were found to be proportional to the content of conjugated polymer backbone, which depends on the functionalization of the (PPE)s. The solid state ⁽³⁾ susceptibilities were also found to be related to the content of polymer backbone in the polymer. Some (PPE)s showed a better long range order, when thermally annealed. This annealing leads to intermolecular electronic interactions which give rise to extended conjugation lengths and hence an increase of the nonlinear optical susceptibility.

We also investigated Fullerenes (C⁶⁰), functionalized with different side groups, for their second-order hyperpolarizability by THG Experiments. As more side-groups were attached, the values of were reduced. We attribute this effect to a disturbance and reduction of the conjugation in the Fullerene due to the new bonds.