Diploma thesis abstract

Photodegradation Kinetics of Semiconductor Polymer Films

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The general disadvantage of semiconductor polymer films is their low stability under the influence of air and light. In this work, we examined the kinetics of photodegradation and obtained the photodegradation cross-section values for semiconductor polymers promising for organic solar cells.

The photodegradation cross-section of polymers $\gamma \cdot \sigma_0$ (where γ is the quantum degradation yield, and σ_0 is the absorption cross-section) characterizes the probability of molecule degradation under the influence of incident photons with wavelength λ_0. The photodegradation cross-section at λ_0 = 532 nm was obtained for commonly used soluble derivatives of poly(phenylenevinylene) (MEH-PPV; $4{,}8 \cdot 10^{-21}$ cm^2), polythiophene (P3HT; $4{,}1 \cdot 10^{-21}$ cm^2) poly(ethylenedioxyselenophene) (PEDOS-C12; $1 \cdot 10^{-23}$ cm^2), and four donor-acceptor copolymers.

It has been observed that those polymers for which $E_T > E_{O2}$ (where E_T is the energy of the triplet state, and E_{O2} is the energy of singlet oxygen) have the photodegradation cross-section value of the order 10^{-21} cm^2. The photodegradation cross-section value for the low-bandgap polymers, for which $E_T < E_{O2}$, is two orders lower 10^{-23} $см^2$. We studied the dependence of photodegradation cross-section on the relative energies of the polymer triplet states and of singlet oxygen, which causes oxidation and further degradation of the polymer.

It is shown that the photodegradation cross-section under the influence of burning radiation with energy $E < 2 \cdot E_T$ is less than that of with energy $E > 2 \cdot E_T$. We suggest that this behavior is associated with singlet fission into triplets, which is an additional channel for generation of the triplet states under high-energy photons.