Polymers and Light

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Polymers and Light: Challenge and Perspectives

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Optical and photochemical properties of polymers are of importance in a number of situations including photoresist systems, nonlinear optics, photochromic systems, and photoconductor applications. Recent advances stem from new materials such as polymers prepared by ring-opening metathesis polymerization (ROMP), conducting polymers, and redox-active polymers. Advances include new methods for duplicating the early events in natural photosynthesis, examples of novel photoconductors, and electroluminescent diodes. Relating structure and composition to function remains an important fundamental aspect of research in the area of polymers. Some specific recent work relates to the use of ferrocene-based polymers confined to electrodes for the sustained photoelectrochemical reduction of CCl_4; fluorescence and energy migration following light absorption by aryl-alkyne rigid rod polymers; energy and electron transfer following light absorption by functional polymers prepared by ROMP having an ordered arrangement of chromophore and quencher(s); and demonstration of a photovoltaic device using an oligomer of polythiophene as the critical device material.

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Linear and Nonlinear Light Chromophore Interactions

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Abstract. Polymers play an important role in the field of photochemical applications and photo-electrical applications. In this article we will focus on some typical examples of using polymers in modern technologies taken from the field of photoconductivity, photochemistry, and nonlinear optical applications. The latter field points towards a new direction, namely using polymers for optoelectronic applications. It will be shown that the technical material requirements for optoelectronic applications are rather different from the requirements which have to be fulfilled for conventional photochemistry and photophysics. It will be more and more the solid-state and semiconductor aspects which will enter the field of research, and developement and these new aspects will be as important as the aspects of conventional polymer physics.

Introduction

Polymers are ideally suited for applications with visible light since they are, in general, nonabsorbing in the visible range and, due to their amorphous structure, they do not scatter light. By implementing chromophores into polymer matrices various light-induced processes can be 'tailored' to special applications such as:

- Special Photochemical Reactions in Polymers
- Light-Induced Structural Changes of Polymers
- Light-Induced Conductivity Changes of Polymers (Photoconductivity)
- Light-Driven Nonlinear Processes in Polymers
- Current-Driven Luminescence Properties of Polymers (Electroluminescence).

Along with the above photonic properties there is a whole series of applications which are based on the various photoreactions as summarized above. These applications are:

- *Photochemistry*: Photo-lithography, Printing Techniques, Photoresist Applications, Optical Memories, *etc.*
- *Structural Changes:* Holographic Applications, Optical Memories, *etc.*

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