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Photochromism: Memories and Switches—Introduction

Photochromism is defined as a reversible phototransformation of a chemical species between two forms having different absorption spectra. During the photoisomerization, not only the absorption spectra but also various physicochemical properties change, such as the refractive index, dielectric constant, oxidation/reduction potential, and geometrical structure. These molecular property changes can be applied to various photonic devices, such as erasable optical memory media and photooptical switch components. Although the first finding of photochromic compounds can be traced back to the middle of the 19th century, they are still awaiting their time to go on the stage of photonic devices. The erasable memory media developed so far have been inorganic materials which utilize the magnetooptic effect or phase change as the basis for optical recording. Organic materials have not been considered as viable candidates because of insufficient reliability. However, the situation is dramatically changing. The worldwide acceptance of CD-R (compact disk-recordable), which uses organic dyes as the memory medium, has changed the situation, and photochromic materials are now anticipated as a promising candidate for erasable memory media of the next generation. In optical fiber switch devices, organic polymers, which change their refractive index by thermal heating, are currently used as the switching components. These components can be replaced with photochromic materials, which change their refractive index by photoirradiation. Organic photochromic materials find many possible applications in various photonic devices.

This issue compiles papers that provide an overview of the basic properties of new and traditional photochromic compounds and their applications to memories and switches. In general, only nonbiological organic photochromism has been covered, the one exception being bacteriorhodopsin. The unique properties of bacteriorhodopsin merit special mention because of its successful application to memories and switches. Irreversible photoreactive systems, such as photoresists, have not been included. For practical applications, evaluating the performance from various points of view is required, including those of electronic engineers and physicists, not only chemists. Just recently, such critical evaluation of photochromic materials has actually been performed. The unique performance of new compounds, such as furyl fulgides and diarylethenes, has aroused the attention of electronic engineers and physicists, and their abilities have been extensively examined. The aim of this issue is to provide the results of such evaluation to those who are interested in general photonics and to entice them into this field.

November 14−18, 1999, the 3rd International Symposium on Organic Photochromism was held in Fukuoka, Japan. More than 200 scientists, including 65 from abroad, participated in the symposium, and 150 oral and poster papers were presented. Photochromic phenomena were discussed from both fundamental aspects as well as practical points of view. Optical neural networks using photochromic memory media, applications to three-dimensional (3D) and near-field optical memory media, photooptical switching devices using photochromic hybrid organic−inorganic materials, chiroptical molecular switches, nonlinear optical properties of photochromic molecules, and liquid crystalline photochromic systems for memories and switches were among the most active topics in the symposium. Most of these new trends were treated in this issue. I hope that the present compilation provides a preview of future development of this field.

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