Photochromic Molecules Composed of Two Negative Photochromic Units

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Positive photochromism is reversible change of molecules from the colored state to colorless state upon light irradiation. We developed various types of positive photochromic compounds, which generate colored biradical species upon UV light irradiation. However, conventional positive photochromic compounds have an issue for the application in bulk materials because of a reabsorption of excitation UV light on the surface by the photogenerated colored species. One of the best candidates overcoming this problem is using negative photochromic compounds. BisDPI-PN is a negative photochromic compound exhibiting multistate photochromism, in which bisDPI-PN isomerizes from colorless 2,2'-isomer to colored isomer via a short-lived biradical, finally it changes into the most stable 1,2'-isomer (Fig. 1).[1]

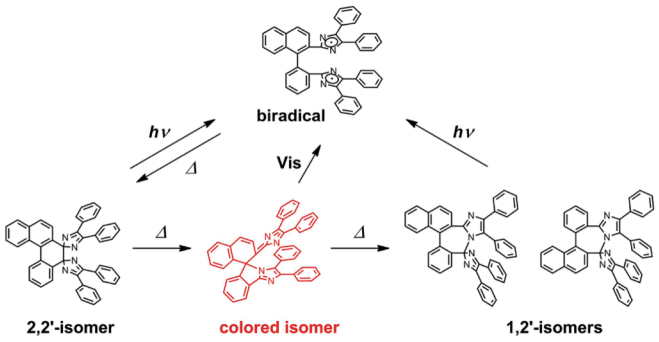

Figure 1. Scheme of photochromic reaction and isomerization of bisDPI-PN

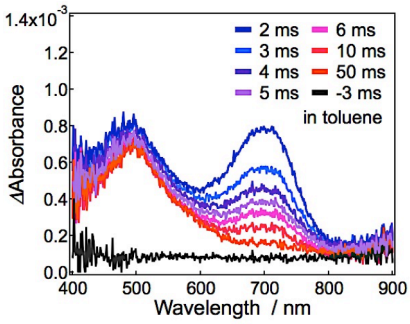

Figure 2. Transient absorption spectra of **1** from 2 to 50 ms after the excitation in toluene at 298 K

Recently, we developed a novel phenylnaphthalene-bridged molecule **1** with two negative photochromophores based on bisDPI-PN to develop advanced photoresponsive materials. Compound **1** also generates several isomers in the same manner as bisDPI-PN. In addition, **1** shows different behavior depending on the excitation light intensity. At low excitation intensity, one photochromic unit generates two radicals and then they recombine thermally. However, at high excitation intensity, the absorption band at 700 nm appears in the transient absorption spectra, and the decay at 700 nm is more than 10 times as slow as that at low excitation intensity (Fig. 2). It would be caused by the interaction between two radical units. The combination of a stepwise two-photon process and negative photochromism has an attractive potential for the efficient use of light.[2]

References:

[1] T. Yamaguchi, S. Hatano, J. Abe, *J. Phys. Chem. A,* **2014**, 118, 134

[2] K. Mutoh, Y. Nakagawa, A. Sakamoto, Y. Kobayashi, J. Abe, *J. Am. Chem. Soc.*, **2015**, 137, 5674