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Optical properties of chiral photomechanical salicylideneaniline crystal

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Mechanical motion caused by UV/VIS radiation onto bulk materials is called a photomechanical effect. In other words, the photomechanical effect is a type of energy conversion systems. Recently, a mechanical bending of photochromic diarylethene crystals was reported, and the molecular-scale motion was found to produce the macroscale bending of the crystals (Kobatake et al., 2007). Subsequently, several photomechanical crystals have been reported to provide promising opportunities for artificial molecular machinery. The mechanism of the conversion of light energy to mechanical energy, however, has not quantitatively been understood. In photomechanical effect, microscale structural change and stress should be involved with optical properties of anisotropy and chirality; linear birefringence (LB), linear dichroism (LD), circular dichroism (CD) and optical rotatory power (ORP). CD and ORP in a chiral anisotropic crystal are extremely difficult to be measured owing exclusively to the contribution of strong linear anisotropy. The High Accuracy Universal Polarimeter generalized by our group (G-HAUP) enables us to measure LB, LD, CD, and ORP simultaneously and quantitatively (Tanaka et al., 2012). The purpose of our study is to investigate the relationship between microscale structural change or stress induced by UV/VIS radiation and the four optical properties. We synthesized chiral N-3,5-di-tert-butylsalicylidene-1-phenylethylamine photochromic crystal, as shown in Scheme 1, because the mechanism of photomechanical effect in this crystal has been revealed qualitatively by analyzing single-crystal structure under UV/VIS radiation (Koshima et al., 2013). The LB, LD, CD, and ORP spectra in the direction perpendicular to (001) were successfully measured under VIS radiation. Furthermore, LD spectrum was found to change by UV radiation in 30mW/cm². These results could contribute to an elucidation of the mechanism of photomechanical effect quantitatively.

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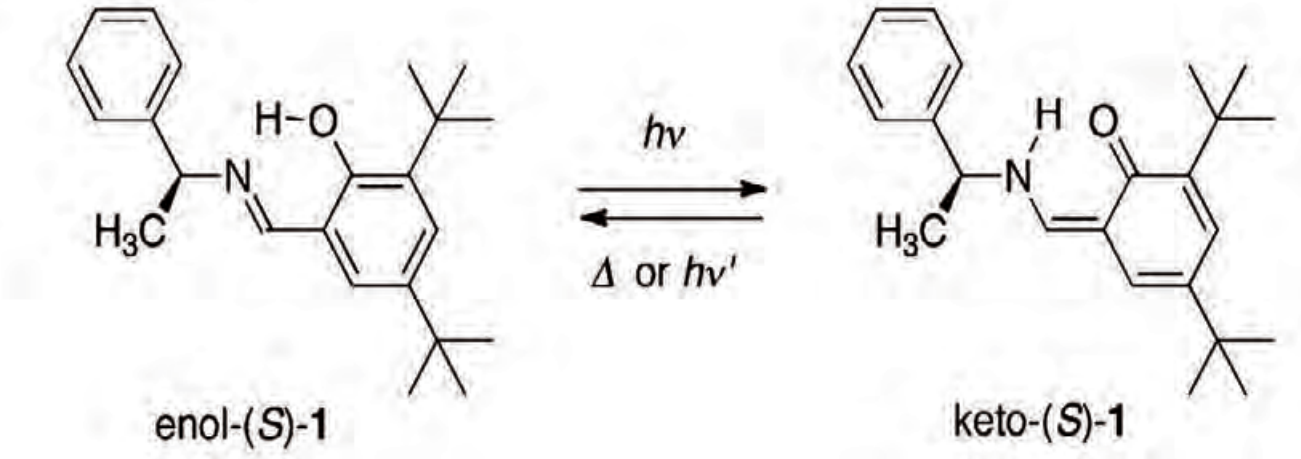
Scheme 1



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