論文 / 著書情報
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題目(和文)	色素ドープ液晶における光分子配向の高感度化と調光材料への応用
Title(English)	Design of dye-doped liquid crystals showing highly sensitive photoinduced molecular reorientation for optical limiting application
著者(和文)	臼井鴻志
Author(English)	Koji Usui
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種別(和文)	要約
Type(English)	Outline

The purpose of this thesis is to enhance the sensitivity of the nonlinear photoinduced molecular reorientation of polymer-stabilized oligothiophene-doped liquid crystals (LCs) and demonstrate that this LC material enables the application of an optical limiter using such molecular reorientation. Here, the author focused on the torque balance in the LC molecular reorientation, and investigated the effects of various parameters of the LC cell on the photoinduced molecular reorientation.

In Chapter 2, the author investigated the effect of surface treatment of the glass substrates constituting the polymer-stabilized dye-doped LC cell on the photoinduced molecular reorientation. The incident light intensity needed for the molecular reorientation decreased by 30 % due to the decrease in the concentration of silane coupler with an alkyl moiety. Because of the decrease in the concentration of the silane coupler, surface anchoring decreased, which increased the sensitivity of photoinduced molecular reorientation.

In Chapter 3, the author designed the highly sensitive LC material with optimized the cell configuration conditions based on the torque balance. Increasing the cell thickness, applied voltage and tilt angle decreased the threshold intensity for photoinduced molecular reorientation. By combination of these factors, the author successfully lowered the threshold intensity below 100 mW/cm^2. Such highly sensitive LC materials enable the development of new nonlinear optical materials that can respond to relatively low intensity light such as laser pointers.

In Chapter 4, the author numerically analyzed the photoinduced molecular reorientational behavior by using the torque balance law and compared with the

experimental results. All the calculation results were in good agreement with the experimental reorientational behavior. Furthermore, the effects of each parameter affecting the torque balance method on the molecular reorientation were investigated, and an approach to further increasing sensitivity was proposed.

In Chapter 5, the author applied the photoinduced molecular reorientation of the oligothiophene-doped LC material to an optical limiter that attenuated a high-intensity light automatically. The transmittance was unchanged under an irradiation with low-intensity light, whereas the incident light with high intensity was attenuated nonlinearly, showing a clear optical limiting behavior. Such optical limiting can be appeared repeatedly at least 100 cycles. Furthermore, by combining the applied voltage, the LC material successfully attenuated the light intensity on the order of nW.

In Chapter 6, the author fabricated the oligothiophene-doped LC film with flexible polymer substrates, and evaluated the effect of bending on the photoinduced molecular reorientation. Even if the prepared LC film is deformed, the molecular reorientation occurred, leading to the fabrication of the highly sensitive and deformable optical limiter.

In Chapter 7, the author summarized the obtained results. In this study, the author designed the highly sensitive LCs doped with oligothiophene dyes, and explored their application for new optical devices. From the viewpoint of torque balance, the author successfully lowered the threshold intensity of photoinduced molecular reorientation by stepwise modulation of torque balance with related parameters, and theorized such molecular reorientation. The author also achieved the reversible optical limiting behavior in response to photoinduced molecular reorientation, which enables one to demonstrate

its application as an optical limiter using the dye-doped LCs. Such LC materials allow for the development to flexible device owing to its soft nature. Therefore, the author conclude that the LC material used in this study functions as the unique optical limiter that has top-class sensitivity and flexibility.