論文 / 著書情報
Article / Book Information

題目(和文)	動的光重合による高分子構造体のホログラムパターン形成
Title(English)	Formation of holographic patterns in polymer structures by scanning wave photopolymerization
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The purpose of this study is to create new functional films by scanning wave photopolymerization (SWaP), to prove that the novel alignment method is an efficient, general and powerful process for fabrication of wide range of high-performance materials. Here, the author conducted the experiment about the alignment of doped dye molecules and spontaneously formed micrometer-scale polymer structures by photopolymerization using spatiotemporal scanning of light.

In **Chapter 2**, an alignment control of anisotropic dye molecules with non-polarized light was demonstrated. It was observed that anisotropic dye molecules were well aligned by optimizing the photopolymerization conditions. This experiment revealed that driving force for alignment of SWaP is valid for a doped anisotropic molecule. Its alignment direction was parallel to the neighboring mesogenic moieties. Thus, it was proved that SWaP enables to align various kinds of materials even if the material does not participate in the photopolymerization without any surface treatment or polarized light sources.

In **Chapter 3**, the author investigated a serendipitous discovery about formation of micrometer-sized periodic structures over large areas. One-dimensional aligned periodic structures were formed by controlling the cooling process. Moreover, the author found that the size of the structures could be changed by the control of photopolymerization conditions. By observation with a polarized optical microscope, it was revealed that the spontaneously formed structure was related to the phase separation of polymers. In addition, detailed investigation elucidated that three-dimensional molecular alignment along the periodic structures was induced in the resultant film.

In **Chapter 4**, the author evaluated optical properties of fabricated grating structures. Measurement of diffraction efficiency and polarization conversion behavior was conducted to examine the light diffraction mechanism of the film. The analysis based on Jones calculus revealed that components of transmission and diffraction are different, and this phenomenon leads to the unique optical properties of the film obtained by SWaP. Moreover, the author demonstrated two-dimensional alignment control of polymer structures by introducing a new optical setup which is able to control the incident light patterns during SWaP for creating new optical functional films. The concentrically aligned structures were successfully fabricated, and its optical properties were evaluated. As a result, it was observed that the resultant film works as a diffraction lens with a short focal length. Furthermore, array pattern of concentric alignment was also demonstrated, which can be applied for some optical devices such as a microlens array.

In this study, the author explored the versatility of SWaP, by the investigation of alignment control in the nano- to micro-scales. The driving force of the molecular alignment in SWaP, which is the light-triggered mass flow, allows to inscribe alignment of several kinds of materials including an anisotropic dye molecule and a polymer structure which is spontaneously formed by phase separation of polymers. By utilizing the optical functions of such polymer structures, the author developed large-area photofunctional materials with unique optical properties, which was difficult to be achieved by the conventional polarization holographic techniques. Thus, it was proved that SWaP also has great potential to generate complex holographic patterns. The author believes that the high versatility of SWaP plays an important role in the manufacture of a great variety of advanced functional organic materials.