論文 / 著書情報
Article / Book Information

題目(和文)	空間選択的光重合による相分離構造の配向制御とメカニズム解析
Title(English)	Orientation control and mechanistic analysis of phase-separated structures formed by spatially selective photopolymerization
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Structural control of phase separation allows the enhancement of material functionalities due to the structure-property relationships. Several control methods utilizing drying, temperature change, or chemical reactions have been developed. However, controlling the mesoscopic orientation of phase-separated structures over a large area remains a significant challenge due to their random nature. Recently, a novel concept controlling molecular/mesoscopic orientation, termed scanning wave photopolymerization (SWaP), has been proposed. During this research, the spontaneous formation of periodically ordered microscale structures by SWaP was serendipitously discovered. In this thesis, the author investigated the formation mechanism of the periodic structure to propose a novel strategy for aligning phase-separated structures through SWaP.

In Chapter 2, the author fabricated polymer films using SWaP with one-dimensionally scanned slit UV light. Detailed POM observation and polarized Raman microscopy revealed that complex three-dimensional molecular alignment pattern along the cylindrical structure was induced in the polymer film. Furthermore, this complex molecular alignment resulted in the anisotropic light diffraction.

In Chapter 3, real-time POM observation was conducted during SWaP with a one-dimensional (1D) scanned slit light, aiming to explore the formation process of periodic structure and molecular alignment behavior. Moreover, image analysis using two-dimensional fast Fourier transform of the resultant movies clarified that the periodic molecular alignment was induced after the formation of

the periodic structures.

In Chapter 4, the author elucidated the detailed mechanism of periodic structure formation by simplifying the system employing spatially selective photopolymerization. Moreover, the detailed dynamics of phase-separated structure formation and molecular alignment were elucidated by analyzing the diffraction behavior observed during spatially selective photopolymerization.

In Chapter 5, the author demonstrated the structural control of phase separation by designing the UV pattern. The evaluation of optical properties revealed that the film obtained by SWaP with the designed UV pattern exhibits unique light diffraction properties, indicating that functional polymer films can be fabricated by controlling phase-separated structures through SWaP.

The author believes that this research contributes to the development of a novel method for controlling phase-separated structures in polymer films and enable the fabrication of next-generation functional soft materials with diverse functionalities.