

【Grant-in-Aid for Scientific Research (S)】
Science and Engineering (Chemistry)



Title of Project : New polymer film processing based on the amplified conversion triggered from the free surface

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Research Project Number : 16H06355 Researcher Number : 40163084

Research Area : Functional polymer chemistry

Keyword : Free surface, polymer thin films, photoalignment, surface morphing, modeling

【Purpose and Background of the Research】

We have been conducting systematic explorations on the photoalignment and surface morphing of photoresponsive liquid crystalline polymer films. Very recently, we found that mesogens in liquid crystalline polymer films can be photoaligned by a surface skin layer of photoresponsive polymer. Alternatively, we also found that large mass transfer is induced on polymer films when another kind of polymer droplet is placed by inkjet printing followed by softening procedure via heating or light irradiation. Based on these new findings, a new project is constituted to create new technology of polymer film processing triggered from the free (air) surface.

【Research Methods】

The research method is constituted of two approaches based on 1) polymer chemistry and 2) polymer physics. 1) Polymer chemistry approach: Attempts will be made to switch the mesogen orientation reversibly by light using the surface skin layer. Mesogen orientations will also be controlled using small molecules at the free surface. 2) Polymer physics approach: Since no knowledge is obtained for the mass transfer process triggered by the hetero-interface, systematic accumulation of data changing the polymer properties is needed. At the same time, physics model will be considered to explain this phenomenon. Collaborations will be made with researchers at University of Hyogo, Tokyo University of Science, and National Composite Center of Nagoya University.

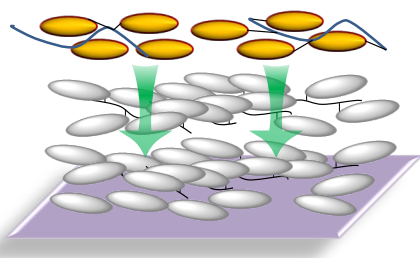


Figure 1 Liquid crystal control from the free surface.

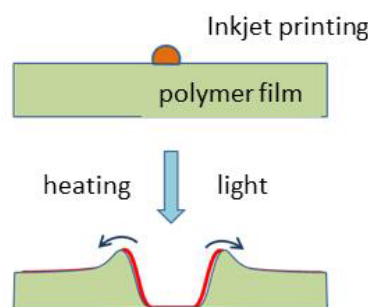


Figure 2 Mass transfer in polymer film triggered by another polymer deposited at the free surface

【Expected Research Achievements and Scientific Significance】

Numerous data have been accumulated for the material processing controlled from the nature of solid surfaces, however polymer processing utilizing the free surface has been hardly studied. The systematic research in this strategy is strongly needed. New proposals of new processing methods for polymer and liquid crystal thin film technologies are expected to be provided.

【Publications Relevant to the Project】

- K. Fukuhara, S. Nagano, M. Hara, T. Seki, Free-surface molecular command systems for photoalignment of liquid crystalline materials, *Nat. Commun.*, **5**, 3320 (2014).
- T. Nakai, D. Tanaka, M. Hara, S. Nagano, T. Seki, Free surface command layer for the photoswitchable out-of-plane alignment control in liquid crystalline polymer films, *Langmuir*, **32**, 909-914 (2016).

【Term of Project】 FY2016-2020

【Budget Allocation】 138,200 Thousand Yen

【Homepage Address and Other Contact Information】

<http://www.apchem.nagoya-u.ac.jp/06-BS-2/seki/abo/index.html>