Molecular Manipulator Driven by Spatial Variation of Liquid Crystalline Order -Design for the photonic structure by the interference fringe of UV-laser-

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Many works on liquid crystal systems containing impurities such as colloidal particles have focused on the collective long-range interactions among micron-scale impurities, resulting from elastic distortion of the liquid crystalline order. When the impurity size decreases substantially, the coupling between the scalar nematic order parameter S and the polymer concentration ϕ becomes relevant instead of the elastic interaction mechanism. The coupling between S and ϕ originates from local molecular interaction, but becomes long-ranged because the total polymer concentration is conserved over the whole sample. We have confirmed the mechanism in which the spatial variation of S generates a 'force' that transports nano-scale impurities mediated by the coupling between S and ϕ [1]. We have also successfully designed a prototype of a molecular manipulator that transports molecules along spatial variations of the scalar order parameter, modulated in a controlled manner by spot illumination of an azobenzene-doped nematic phase by UV light as shown in Fig.1.

The manipulator can control the spatial variation of the polymer concentration; therefore it shows promise for use in the design of novel hybrid soft materials. Recently, we have improved the resolution of the manipulator by the polymerization of the azo dye molecules and using interference fringe pattern of He-Cd UV laser. In case of the free azo dye molecules, the order parameter variation is rather broaden in comparison with the size of the UV light spot due to the translational diffusion of excited cis molecules. Resolution of the order parameter variation can be improved until which is equivalent to the resolution of the UV interference fringe pattern as observe in Fig.2. Now, we are developing the molecular manipulator to produce the photonic crystal with regular arrangement of the metal nano particles in LC.

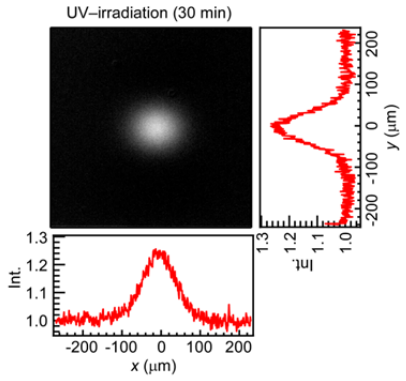

Figure 1: Fluorescent molecules are manipulated in the central region, where the order parameter is weakened by cis azo-dye molecules excited by UV illumination.

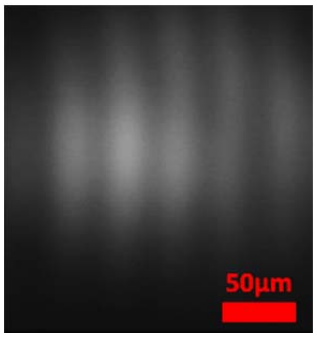

Figure 2: Improvement of the resolution of the molecular manipulator by fringe pattern of He-Cd UV laser.

1. S. Samitsu, Y. Takanishi and J. Yamamoto, Nature Materials, **9**, 816-820(2010).