Photosynergetic Control of Mesoscopic Systems by Using Radiation Force and T-type Photochromic Reactions

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Optical manipulation techniques of nano or micro objects are of great interest owing to their wide variety of potential applications [1]. When trapping an optically transparent object such as polystyrene or silica nanoparticles using a tightly focused CW laser beam, mechanical motions of the nanoparticle are mainly regulated by the gradient force in the presence of small contribution of the scattering force. On the other hand, for the case of the target object having light absorption at the trapping wavelength, absorption force acting on the target arises in addition to the gradient force. In the present work, we have studied switching of radiation force acting on optically trapped polymer particles through photochromic reactions. This approach aims to realize the photosynergetic response between radiation force and photochemical reactions for controlling mesoscopic systems.

Polymer particles incorporating naphthopyran derivatives (NPs) undergo coloration/discoloration through the photo-induced isomerization reactions [2]. Molecular structures of the NP derivative are shown in Fig.1a. These particles were suspended in water for optical trapping. For the trapping experiment, we used an inverted optical microscope and CW lasers with 355 and 532 nm (Fig. 1b). The focused 523-nm laser beam was used for trapping of the individual polymer particles. Mechanical motions of the trapped particle were monitored by transmission imaging. To induce the reversible switching of the radiation force, population ratio between the colorless and the colored isomers of NP in the polymer particles was adjusted by irradiating 355 nm laser. At the symposium site, we will discuss mechanical motions of the polymer particles induced by absorption force of NPs.

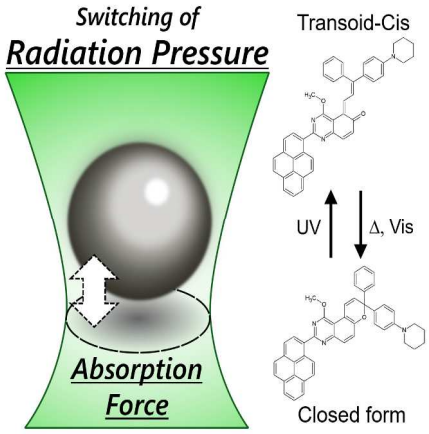

Figure 1. Schematic illustration of switching of radiation force by using photochromic reactions of NPs.

[1] A. Dogariu, S. Sukhov, and J. J. Sáenz, *Nature Photonics* **2013**, 7, 24.

[2] Y. Inagaki, Y. Kobayashi, K. Mutoh, and J. Abe, *J. Am. Chem. Soc.* **2017**, 139, 13429.