円偏光の光圧による液晶微粒子の回転誘起と光化学反応による回転速度制御

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Rotational Motion of Single Microparticles of Liquid Crystal Driven by the Photon Pressure of a Circularly Polarized Light and Its Speed Control using Photochromic Reactions (*Graduate School of Engineering Science, Osaka University*) ○ Kazuki Ban, Takayuki Nanno, Syoji Ito, Hiroshi Miyasaka

Photon pressure acts on an object as a reaction to the momentum change of photons due to light scattering, absorption, and refraction. The photon pressure can be used to manipulate micro-objects and its strength and direction can be tuned by controlling photo-responses of the targets. For instance, we have recently reported the control of the photon pressure (absorption force) on a nanoparticle through photochromic reactions and demonstrated micro-reciprocal motion of the nanoparticle.[1] Not only linear motions but also rotational motions of birefringent micro-objects can also be achieved by using photon pressure of a linearly polarized laser. In the present study, we aim to control the rotation of micro-objects by combining photon pressure and photo-chemical reactions.

Azobenzene (AzB) was added to the liquid crystal (LQ) 6CB showing a nematic phase at room temperature, and the mixture was dropped into water and subjected to ultrasonic treatment to obtain the aqueous dispersion of 6CB micro-droplets containing AzB. First, a single LQ droplet was optically trapped with a circularly polarized 1064-nm laser under a polarizing microscope, confirming the rotational motion of the droplet. Next, the photoisomerization of the AzB was induced by UV irradiation and, it was observed that the birefringence of the LQ droplet disappeared by the UV exposure, indicating that the control of torque is possible by the photoisomerization. At the conference, we will discuss the controllable frequency range by this method and the correlation between the number of photo-isomerized molecules and the rotation speed.

Keywords: photon pressure, circularly polarized light, liquid crystal, photoisomerization

光照射された物体には、光の散乱、吸収等による光子の運動量変化の反作用として光圧が作用し、微小物体の操作が実現可能となる。我々はこれまでに、光の進行方向に作用する光圧(吸収力)をフォトクロミック反応により制御することで、直線往復運動を示す光駆動微小システムの構築が可能となることを報告した [1]。本研究では、より高度な光駆動の実現を目指し、円偏光光を複屈折性の物体に照射した場合に生じる偏光の回転方向に沿ったトルク [2]と光化学反応を用いて、微小物質の回転運動の誘起と制御を目的とした。

室温でネマチック相を呈する液晶 6CB にアゾベンゼン(AzB)を添加し、水中に滴下し超音波処理を施すことで AzB を含んだ 6CB マイクロ液滴水分散液を得た。まず、AzB の光異性化誘起前の単一液晶液滴を円偏光の近赤外レーザーで偏光顕微鏡下に捕捉し、回転運動を確認した。その後、UV 照射により AzB の光異性化を誘起し、液晶液滴の複屈折性が光照射によって消失することを観測し、光異性化によりトルク制御が可能であることを示した。講演では，制御可能な周波数帯域や反応分子数と回転速度の相関などに関して議論する。

References

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