# 남조류의 파장에 따른 주광성 속도 측정

# Precision Measurements on Phototatic Properties of Cyanobacteria

우숙이[1], 김택겸[1], 김순환[1], 정세채[1], 김수연[2], 박연일[2]
[1] 한국 표준과학연구원 미래 신수요측정그룹 305-340 대전 광역시 도룡동1번지 ,
[2] 충남대학교 생명과학부 생물학과[2] 305-764 대전 광역시 궁동 220번지
vinu2994@kriss.re.kr

Many photosynthetic microorganisms have been evolved to sense the color as well as the irradiance of light in order to maintain the optimal living conditions under given environment.(1) Cyanobacteria, which is one of most prevail photosynthetic microorganisms, exhibits a phototactic gliding movement forward to the direction of visible and NIR region (positive response). For UV-A region, however, the microorganisms run away from the light source (negative response).(2) The previous researches on the mechanism on its phototaxis reveals that a protein TaxD1 plays an important role in the determination of the either positive or negative response direction. However, it is not well known about the dependence of exact velocity for the phototaxis on the light intensities at a specific wavelength. Furthermore, the micro-torque generated by the microorganism should be valuable to have further deeper understandings on the phototaxis.

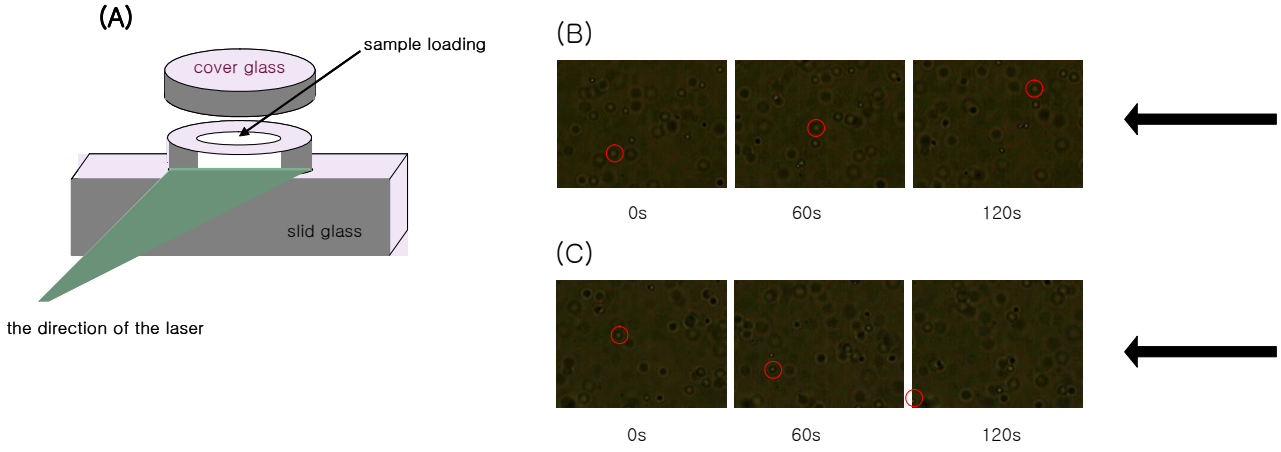


Fig 1. Phototaxis assay in wild-type cells. The microorganism was placed in home-made sample cells (A). A hole with a diameter of 15 ㎜ was made by fs-laser micromachining on a cover glass with a thickness of 150 ㎛. The processed cover glass was placed on the slide glass. The cell suspension was put on the center of the hole of cover glass and lid slide glass was put on the samples with sealing a possible leak. The side of the sample container was painted black color.(3) (B) and (C) is the optical images for phototactic movement with a time lapse of 60 seconds upon irradiation at 442 ㎚ and 325 ㎚, respectively.

In this work, we have measured the phototaxis for not only a wild type strain (WT) but also two different mutant strains, which is genetically engineered to lose the negative response to UV-A (MT-A and MT-B) with keeping the positive phototaxis. While the previous studies use a light source with broad band from xenon lamp, we have used laser beam at the wavelength of 325 ㎚and 442 ㎚ from He-Cd laser for negative and positive responses, respectively. The microorganism was put in home-made shallow incubator with a thickness of 150 ㎛, of which side edges are blocked except light entrance. (Fig. 1 (a))

Under dark condition, the microorganism is effectively at rest. Exposure of the cells with the laser beam triggered the phototatic activities and then resulted in almost static speed after about 1 min. Fig. 1(B) and (C) exhibit a typical optical micro-graphical images for the phototaxis of wild type cyanobacterials obtained upon steady photoexciation at 442 ㎚ and 325 ㎚, respectively. The observed direction of the phototatic movements for positive and negative responses is in agreement with the previous measurements. However, its speed of around several ㎛/sec is much higher than those reported values less than 1 ㎛/se.c. Furthermore, the trajectories of the movement under current work is almost linear while the microorganism track reported from the previous work is very complicated. It should be also interesting to note that even about 1 min after closing the laser beam the cells are still moving. Further works on the phototaxis for mutated microorganism reveals the evident positive response to the visible laser beam with activity for the negative response on the UV light at the wavelength 325 ㎚. We have observed that WT cells moved faster than MT-A and MT-B cells upon photoirradiation at the wavelength of 442 ㎚. The latter cells are moving at a speed of about 3 ㎛/s, while WT cells is about 3.4 ㎛/s. Based on the measurements of the torque for the phototaxis in addition to the above results, we will discuss about the nature of the phototaxis inherited in the microorganism.

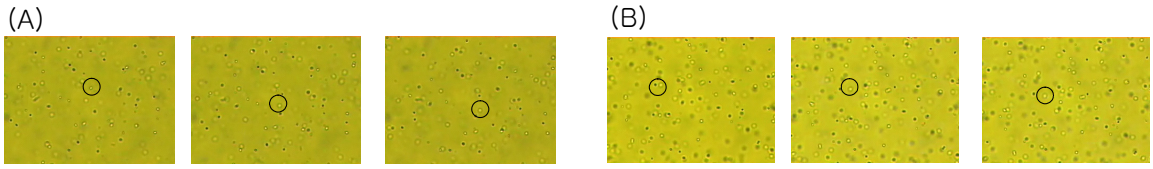


Fig 2. Phototaxis assay for mutant cells (MT-A, MT-B). Analysis of phototactic movement per 30 sec with 514 nm (A) and 325 nm (B). The movement of the cells was still maintained 1 minutes after closing the laser beam.

Reference

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