

Effect of Static Magnetic Fields on Firefly Bioluminescence

Masakazu Iwasaka

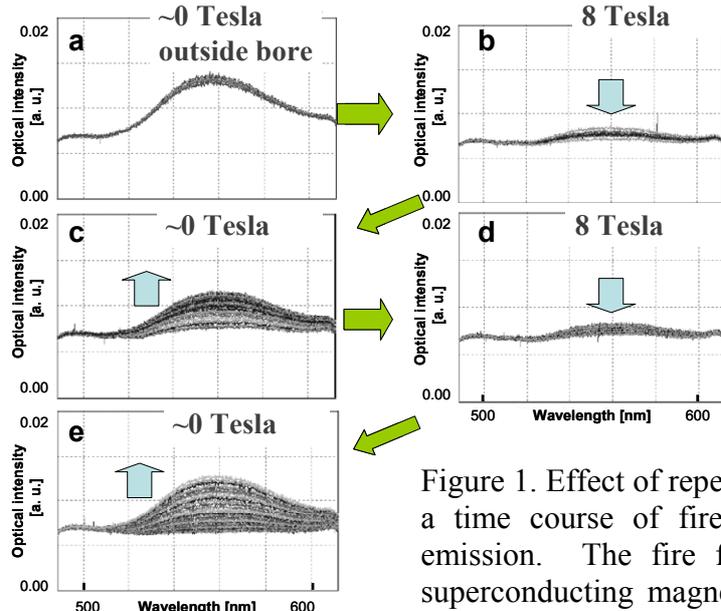
Chiba University, 1-33 Yayoicho, Inageku, 263-8522 Chiba, Japan

email: iwasaka@faculty.chiba-u.jp

Bioluminescence is a unique system utilized by living creatures, such as fireflies and lightning bugs, for the purpose to communicate with each other. The system can provide a highly sensitive evaluation system for biomagnetic studies because it enables direct investigation of the effects of magnetic fields on living systems by measuring light emissions in real time. The bioluminescence of firefly is a kind of photochemical reaction that involves a substrate, luciferin, and an enzyme, luciferase. In the previous studies, we observed the enzymatic reaction of luciferin and luciferase both in vitro and in vivo, and the results showed that the emitted light intensity of 560nm decreased and the peak wavelength slightly shifted to higher wavelengths by the magnetic field exposure of up to 14 Tesla [1]. In the present study, we investigated the effects of magnetic fields of up to 8 T on the emission spectra of firefly, *Luciola lateralis*, for the purpose of checking the reproducibility of the phenomena.

An optical measurement system with cooled CCD type of optical photometer was introduced for the real-time measurement of firefly's emission under the strong static magnetic fields. The firefly light organ was fixed at the edge of an optical fiber, and the emitted light was introduced into the CCD photometer system. We measured both the spectrum of a light emission and the time course of bioluminescence.

First, pulsed emission spectra in the range of 540 nm to 580 nm were collected every two seconds, and an averaged spectrum was obtained. Immediately after placing the light-emitting organ of the firefly at the end of an optical fiber, the optical emission peak at 560 nm gradually shifted to higher wavelengths as the magnetic field was applied, and shifted to a lower wavelength when the firefly was moved away from the 8 T. In the next study, a time course of bioluminescence during a static emission was measured. The intensity of emission decreased under 8-T magnetic fields; it was observed to be reversible as shown in Fig. 1.



It was speculated that the oxygen molecules transport in/around the firefly light-emitting organ was influenced by the magnetic fields. The specific mechanism, such as magnetic force, magnetic orientation or radical pair mechanisms, was not determined at the present study.

Figure 1. Effect of repeated exposure at 8-T magnetic fields on a time course of fire fly bioluminescence during a static emission. The fire fly was moved between the bore of superconducting magnet and its dummy bore which had the same condition except the magnetic fields.

Reference

[1] M. Iwasaka and S. Ueno, *Journal of Applied Physics*, **83(11)**, 6456-6458 (1998).