

Control of Light Scattering in Biogenic Micro-Crystals by Diamagnetic Rotation

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Biogenic crystals, such as fish guanine crystal plate and uric acid crystals are generated for the purpose of controlling environmental light fields and due to biological degradation, respectively. Recent studies have revealed some of new aspects in magnetic and optical properties of the guanine, uric acid, cellulose and calcium carbonate. In this paper, we discuss on the advances in measurements/control methods for magnetic responses of biogenic micro-crystals focusing on possible applications for biotechnology and biomedical engineering.

On the surface of living body, fishes and insects are utilizing periodical structures making photonic properties. In case of fishes, guanine crystals are formed inside chromatophore and form a stack of crystal plates, which acts as an efficient biologically-prepared light control devices. The optical device, a kind of organic crystal mirror, assembles by connecting to macromolecules in cell, and its light scattering property has a potential to generate new optical functions for biotechnology. We developed a new method to investigate the light scattering anisotropy in biogenic micro-crystals. Figure 1 shows three kinds of combination of three vectors; direction of observation, incident light and magnetic field. Left panels are time-courses of light scattering changes during micro-crystal-like cellulose, which oriented perpendicular to the applied external magnetic fields, magnetically oriented. The two modes in upper and middle panels show a light scattering decrease. Uric acid crystal orienting perpendicular to magnetic fields also had a same light scattering behavior, while fish scale guanine crystals orienting parallel to magnetic fields exhibited a different property. These light scattering properties are explained in detail by considering the back scattering cross section of micro-crystals. The proposed method of light scattering anisotropy measurements utilizing diamagnetic rotation of micro-crystals in liquid is the seed for a diamagnetic floating or flexible actuator.

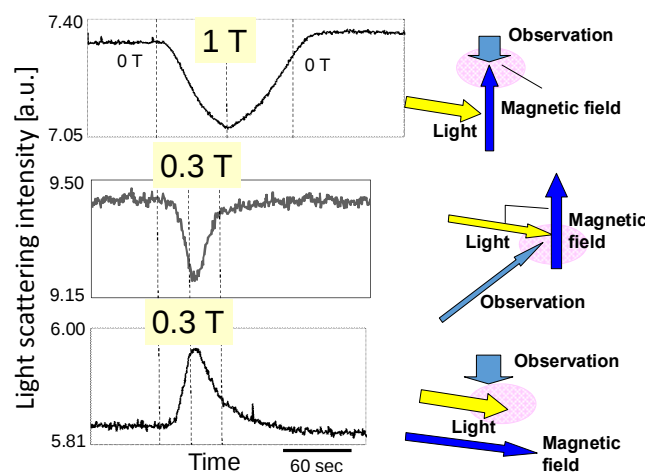


Figure 1. Light scattering anisotropy of magnetically rotating micro-crystal-like cellulose crystals floating in an aqueous solution.