論文の要旨
(Thesis Summary)

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論文題目 Study on the utilization of bio-crystals for bio-sensing
(生体計測のための生物由来結晶利用法の研究)

Chapter 1 states briefly the research objective of this thesis study and details on diamagnetic susceptibility of guanine are discussed in *Chapter 2*. The aim of this doctoral thesis study is to analyze the possibility of utilization of guanine crystals for Bio-sensing. In this doctoral study we performed the following assessments;
i) Analysis of quenching of flickering of biologic guanine crystals under magnetic fields of 0.5T, ii) Recrystallization of synthetic guanine particles for artificial micro-mirror fabrication for biological use, iii) An in-vitro vesicle model for analyzing interaction of guanine molecule with organic compounds.

Chapter 3 focusses on discussing the assessment of the dynamic behavior of synthetic guanine particles under a static magnetic field (MF) at 5 T. Flickering light intensities were inhibited under MF, and further analysis revealed a change in the flickering frequency under MF of 300-500 mT (milli-tesla). However, applying the magnetic fields at 500 mT caused an entrainment of the particle vibration at 20Hz. This quenching phenomenon of the guanine particles could serve as a micro-mirror for detection of bacteria in the surrounding aqueous medium.

To reduce procurement of biogenic Guanine Crystals (GC) from fish, we considered it to be fascinating to fabricate a GC with external properties of a specific suitable shape to be identifiable as similar to biogenic guanine, along with a magnetic orientation and light reflective properties will be beneficial to develop a photo-optical reflective system.

Chapter 4 discusses guanine powder recrystallization by Ostwald ripening method. Microscopic analysis of recrystallized guanine indicated that they showed strong light reflective properties, with an average size of several tens of micrometers; and XRD diffraction revealed they belonged to the same classification system of GC. However, XRD patterns showed that the direction of growth and their reflecting surface differed from biogenic crystals. After they were ground slightly, optical and magnetic-orientation characteristics of synthetic crystals improved, with properties relatable to magnetic control of light reflection from biogenic crystals.

Skin of aquatic creatures consists of guanine crystals enclosed in transparent thin bi-layered sacs (iridosome) that allows light to enter and be reflected from inside freely, thus allowing structural light reflection from mammalian skin. We presumed that vesicles could serve as in-vitro iridosome models for our analysis. *Chapter 5* discusses interaction with guanine crystals derived from Japanese koi-fish with biological lipid molecules, primarily to understand its interaction of guanine with biological molecules. Results showed GC interacted with vesicles interestingly, indicating its affinity to biological molecules. These findings prompt further research into application of GC as a potential candidate for photonic bio-imaging. Further we noticed that GC dispersed freely without clumping in organic solutions like methyl methacrylate (MMA) solution, while maintaining their reflective property.

Lastly, *Chapter 6* explains the future potentials uses of findings from these studies and scope for future development and applications.