Diamagnetic responses in biogenic micro crystals and possible application for micromirror device

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Living creatures such as fish and algae are utilizing micro crystals which are genetically produced in cellular tissue. In case of fishes, guanine crystals are generated in chromatephore on the surface of fish body, and control the structural colors for the purpose of utilizing solar light reflection. Some of alga carry out photosynthesis and fix the carbon dioxide. Coccolithophore is one of the alga that forms calcium carbonate crystal by biomineralization. Coccolith is a dish shaped assemble of calcium carbonate crystals whose physiological functions unrevealed at present.

In this report, we observe quick responses of the biogenic crystals of both fish and algae under magnetic fields. At first, we found a drastic change of light scattering in goldfish scale guanine crystals under magnetic fields of 5 T ~10 T. A structural color in guanine crystal array was changed during the magnetic field sweeps. A determination of threshold of the magnetic field effect revealed that the minimum magnetic fields for the light scattering inhibition was around 200 mT for the case of the biogenic guanine crystal plate. The crystals caused a diamagnetic orientation at several hundreds of mT and changed the light reflection direction. The same kind of measurements were carried out on the coccolth discs of coccolithophore, *E. huxleyi*. We observed a change in structural colors in an aggregation of coccolith discs during magnetic field changing between 0 T and 2 T. However in the same manner with guanine crystals suspension, a homogeneously isolated coccolith discs showed a magnetic orientation at 400 mT. We obtained a light scattering changes which depended on the combination of the directions of light, magnetic field and the observation.

The employed micro crystals were floated in an aqueous solution with a Brownian motion. The magnetic response at 200 mT suggested that their diamagnetic energy exceed the thermal energy kT. A simple calculation of the energy supported this hypothesis. It is expected that the magnetic control of the floating micro crystals can be applied for the micro-mirrors in wet MEMS that will provide a new micro-fluidic device for biomedical systems.

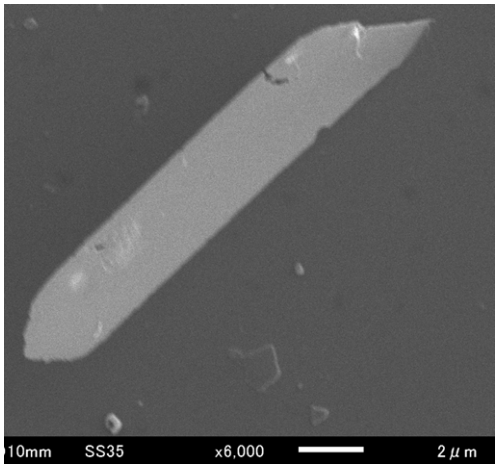

Fig. 1. SEM image of a guanine crystal Plate from goldfish scale.

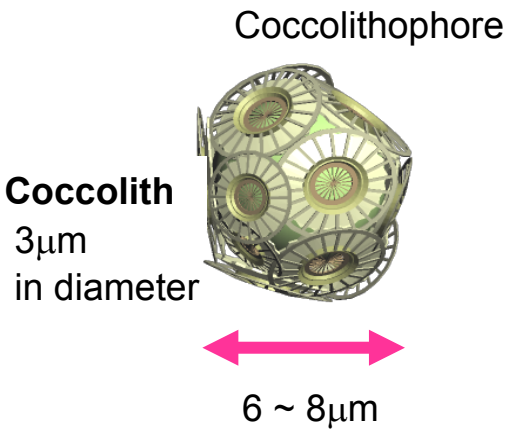

Fig. 2. Illustration of a coccolithophore cell with calcium carbonate crystals discs so called coccolith.

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