2. Growth of Interface-floated Lysozyme Crystals (Videos: 5-8)

<Explanation>

The CCD camera used for observation was improved so that the growth of interface-floated lysozyme crystals can be observed from above. Observations were carried out at intervals of 30 minutes. The magnetic field was applied in the direction from the recess of the screen to the front. We can find that the *C*-axis of the crystal is oriented perpendicularly to the direction of the magnetic field. This observation equipment was manufactured privately.

<Notes for videos>

When no magnetic force is present (0 T), the crystals do not float up but are deposited on the bottom of the vessel (**Video 5A, 5B**).

When the magnetic force is slightly increased (3.0 T), the crystals are deposited in the gas-liquid interface (**Video 6**), but the force keeping the crystals in the interface is weak and the crystals seem to move about over the interface until the interface is covered with them.

When the magnetic force is increased more (4.0 T), the effect of the crystals moving about over the gas-liquid interface is somewhat lessened (**Video 7**).

When the magnetic force is increased further still (5.0T), there is a greater reduction in the effect of the crystals moving about over the gas-liquid interface (**Video 8A, 8B**).

These phenomena occur for the following reasons. When the magnetic force is increased, the upward magnetic force exerted on the crystals likewise increases. As a result, the force holding the crystals in the gas-liquid interface becomes stronger. By contrast, the paramagnetic solution is pulled downwards by the magnetic force and this makes the solution meniscus horizontal. As a result, it becomes difficult for the crystals to slide down over the interface. For these reasons, the effect of the crystals moving about over the gas-liquid interface is reduced when the magnetic force is increased.

Note) Videos 5 to 8 show empirical scenes where the Value $B_z \cdot \mathrm{d}B/\mathrm{d}z$ becomes maximum (Position: 107 mm above the coil center), allowing the crystals to float with a small magnetic force more efficiently than in the cases of videos 1 to 3.

<Place of execution>

National Institute of Advanced Industrial Science and Technology, Kansai

(Note: The reproducibility of the same phenomenon has been confirmed through experiments at the Faculty of Pharmacy, Osaka Ohtani University.)

<Research paper>

S. Maki,

"Effects of magneto-Archimedes levitation on the quality of HEWL crystals: evaluation with white X-ray topography",

International Journal of Biomedical Soft Computing and Human Sciences **19**, pp. 7-15 (2014).

<Patents>

Patent No. 3711386, (patent application number 2002-213229 in Japan)

Patent No. 4273222, (patent application number 2002-360069 in Japan)