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Dependence of impurity adsorption on the step morphologies and growth rate of tetragonal lysozyme crystal

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High quality protein crystals are required to get the information of the 3-dimensional structure of protein molecules. Impurities, mainly dimer molecules, affect the quality of protein crystal strongly (Yoshizaki et al., 2006). In addition, it is known that the step morphology on {110} faces of the tetragonal lysozyme crystal is changed by impurities. Until now, a lot of space experiments were carried out to get high quality protein crystals under microgravity conditions (McPherson, 1993, etc.). However, the relevance between impurity effects and microgravity condition is not clear. In addition, the step morphology corresponding to the crystal external form is not observed in preceding studies.

We performed ”in situ” observations under terrestrial environment and space environment using a tetragonal lysozyme crystal as the model protein. The purpose of this paper is to reveal ”the influence of microgravity condition to the impurities adsorption on the {110} faces” and ”the reason why the step morphology corresponding to crystal external form does not appear”. We made it possible to observe the step morphology and to measure the face growth rate at the same time by using a Michelson type interferometer.

As a result of growth rate measurement, the face growth rate under microgravity condition was higher than that under terrestrial condition. An impurity works to suppress the growth rate of a crystal. Because the buoyancy-driven convection was suppressed under the microgravity condition, we assumed that the larger impurity-depletion-zone was formed around a crystal.

As a result of the observation of the step morphology, we succeeded in observing the lozenge shape step which was corresponding to an external form by a space experiment for the first time. In addition, the step morphologies were classified in four types. It is considered that the impurity adsorption on the crystal surface is different depending on the crystal orientation of the step.