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宇宙実験に向けた干渉法によるリゾチーム結晶成長速度測定
Growth Rate Measurement of Lysozyme Crystal using Interferometry for Space Experiment

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The growth rate of a lysozyme crystal in the solution under microgravity condition was measured at the Foton-M3 mission [1] and at the parabolic flight experiment [2]. In both cases, the growth rate under microgravity condition was larger than that under terrestrial condition. It was considered that the lack of buoyancy convection under the microgravity modifies the distribution of impurity molecules nearby the crystal-solution interface. However, the reason why the growth rate increased under microgravity was still not clear because the experimental data of the growth rate under microgravity was limited. In order to answer this question, we are planning to measure the growth rate of the lysozyme crystal under microgravity condition at the International Space Station by in-situ observation.

We employ Michelson interferometer for the growth rate measurement at the Space experiment.The Michelson interferometer is the strong instrument for the surface observation and the growth rate measurement because nano-order difference in height on the crystal surface can be measured by the interference fringes. However, the problem for the growth rate measurement using the interferometer is the external disturbance like mechanical vibration and temperature changes, which makes difficult the measurement by moving the fringes. To avoid such disturbances, Tsukamoto et al. used the cell glass surface, on which a sample crystal settled, as a reference to cancel the disturbance from the growth rate measurement [3]. Sato et al. used gold particles settled on the sample crystal surface as the reference [4]. These techniques are very powerful to measure the growth rate precisely, however, they are not applicable for the Space experiment because of the following reasons. First, the reflected light from the lysozyme crystal surface is too weak comparing with that from the glass surface to observe clearly. Second, for the space experiment, gold particles cannot be used because they may not settle on the crystal surface but float in the solution under the microgravity condition. To solve these problems, we use a glass plate is used as the reference to evaluate the external disturbance in the measurement of the growth rate by using Michelson interferometer.

We set up the Michelson interferometer and carried out the growth rate measurement of lysozyme crystal on the growund as a pre-experiment. We put the glass plate at the side of the lysozyme crystal and observed surfaces of the crystal and the glass plate simultaneously. The movement of the fringes on the glass plate is only due to the external disturbance, therefore, it is used to cancel the disturbance from the fringe movement on the crystal surface. We obtained the growth rate of the lysozyme crystal and compared the measured growth rate with the previous measurement [5]. We succeeded to measure the growth rate of an order of 0.01 nm/s appropriately by the Michelson interferometer.

References

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