Measurement of Thermal Conductivity and Thermal Diffusivity of Hen Egg-White Lysozyme Crystals which are Crystallized in Containerless Conditions

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Protein crystals are fundamental biological substances to develop the analysis of X-ray structure. In order to make larger crystals, accurate thermal control has been required. However, the measurement research of thermal conductivity and thermal diffusivity of protein crystals is insufficient. Moreover, according to fragility and complexity of nucleation control of protein crystals, the crystallization process should be conducted in containerless conditions. To solve these problems, the magneto-Archimedes effect method and two-liquid method have been conducted. In both methods, the protein crystals were crystallized from protein solution by salting out, where gadolinium chloride was used as precipitant agent. In the magneto-Archimedes method, the high paramagnetic susceptibility of gadolinium chloride plays important role. In this case, the protein crystals were crystallized at the interface between liquid and gas. On the other hand, for the two-liquid method, fluorinert was used. The density of protein crystals was lower than solution and higher than the fluorinert; therefore the protein crystals grow at the interface of two liquids. The thermal conductivity and thermal diffusivity of hen egg-white lysozyme (HEWL) crystals were measured by the transient short hot wire method. In this method, a platinum short hot wire was used according to its features that has excellent linearity of electric resistance against the temperature and excellent processability. We verified that crystals were grown at the interface of solution and that the thin platinum wire was entirely covered by crystals. The thermal conductivity and thermal diffusivity were measured with a temperature range 9.7 to 18.7 ^{o}C. The result of thermal conductivity and thermal diffusivity of lysozyme crystals were found to be 0.359-0.442 W/(m.K) and 1.62-2.42E-07 m^2/s. The measured thermal conductivity agreed well with the result of former tungsten hot wire measurements.