Crystal growth and characteristics of lysozyme crystals

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Many studies on crystal growth mechanisms of the hen egg-white lysozyme protein crystals have mainly performed by optical microscopy and atomic force microscopy (AFM). As results, two types of growth mechanisms, which are a two-dimensional nucleation mechanism and a spiral growth mechanism, were identified. However, there was no direct evidence of grown-in screw dislocations at the spiral sites. We first observed the screw dislocations in tetragonal lysozyme crystals using synchrotron X-ray topography. In addition, to confirm the characteristics of dislocations, we have observed some elastic constants in lysozyme crystals in terms of the sound velocity measurement by pulse echo methods.

Tetragonal hen egg-white lysozyme crystals were grown by the concentration gradient method. The crystals were grown in test tubes, with an inner diameter of 8 mm and 80 mm in length, held vertically. The test tubes were kept at 23C for 2 weeks. The maximum size of crystals were 3×3×4 mm^2. The high quality crystals were examined by Laue topography with a water filter using synchrotron radiation. Figure is a X-ray topograph. Several straight screw dislocations were observed. We also determined Burgers vector to be a [110] direction.

The measurement of sound velocity was performed by the digital signal processing method. The crystals were placed in stainless steel vessel, which was filled with lysozyme solution used for crystal growth. We observed the longitudinal sound velocity along the [110] direction in the tetragonal is obtained to be 1817 m/s. Therefore, Young modulus and shear modulus were evaluated to be 2.70 Gpa and 1.02 Gpa, respectively, if we assumed Poisson ratio is 0.33. These results will be discussed at the meeting.