

Specific Surface Free Energy and Roughening Transition of Sodium Chloride Single Crystal

*Ryoya Maruyama¹, Takaomi Suzuki¹

1. Graduate School of Science and Engineering, Shinshu University

Specific surface free energy (SSFE) is one of important values to discuss the morphology and growth of crystal, and theoretically well discussed. However, experimental trial to determine the SSFE of crystal is very few. We have already measured contact angle of liquids on crystals, for example, apatite, ruby, and quartz in order to determine the SSFE. The SSFE of crystals were proportional to growth rate of crystals, which qualitatively satisfy Wulff's relationship. Experimentally determined SSFE is not that of ideal flat face, but it includes step free energy. This time we tried to measure the step free energy of sodium chloride and discussed the roughness of crystal face.

Sodium chloride single crystal was synthesized by evaporation of saturated water solvent keeping at 40°C. Cubic crystal with (100) face was obtained. Octahedral sodium chloride single crystal with (111) face was also synthesized from water solvent with 15% of formamide keeping also at 40 °C. Crystals was heated by electric furnace at 600°C and kept for 1 hour.

Droplets of ethylene glycol or diethylene glycol with volume of 0.1μL were dropped on the crystal surface using a micropipette. The contact angle were observed using digital camera.

SSFE were calculated by Wu's harmonic mean equation and Fowkes approximation. The calculated value of SSFE of (100) surface before and after heat treatment were 45.9, 48.8mN/m, and SSFE of (111) face before and after heat treatment were 37.9 and 38.9mN/m. The SSFE was increased by heat treatment for (100) and (111) face. Because the observed SSFE contains step free energy, the increase of SSFE is caused by increase of steps on the crystal face. The increase of SSFE was observed after the heat treatment at 600°C. Therefore, the roughening temperature is considered to exist at the temperature under 600°C.

Keywords: specific surface free energy, sodium chloride single crystal, roughening transition