

Surface Gibbs Energy of NaCl Measured by Contact Angle Method

Hitoshi Shindo, Kiyo-aki Iwata and Kozo Shitagami

Department of Applied Chemistry, Faculty of Science & Engineering

Chuo University, Tokyo, Japan

1. Surface Gibbs energy measured by contact angle method

Contact angle θ_{SL} between a solid(S) and a liquid(L) is determined by the relation between the work of adhesion(W_{SL}) and surface and interface energies (γ_s , γ_L and γ_{SL}) as

$$W_{SL} = \gamma_s + \gamma_L - \gamma_{SL} = \gamma_L (1 + \cos \theta_{SL})$$

Assuming additive property in interaction between three components each of surface energies γ^d (dispersion), γ^p (polarization) and γ^h (hydrogen bond) of solid sample S and three well known liquid sample L as

$$W_{SL}/2 = (\sqrt{\gamma_s^d} \sqrt{\gamma_L^d}) + (\sqrt{\gamma_s^p} \sqrt{\gamma_L^p}) + (\sqrt{\gamma_s^h} \sqrt{\gamma_L^h})$$

contact angle data.

After testing the method with three low index surfaces of CaSO₄, we have applied it to NaCl(001), (110) and (111). However, the obtained values were too small and sometimes unreasonable. Strong polarization at the surface probably modified the structure of the liquid surface. We cannot use contact angle data in quantitative discussion of the surface energy. We must be satisfied with qualitative discussion.

2. Atomic force microscopic observation of flattening process of NaCl(001)²⁾

In in-situ AFM observation of NaCl(001) in the saturated aqueous solution, we have observed atomic processes of flattening. Small fluctuations in monatomic step propagation make corner sites where electrically neutral steps along the crystal axes intersect. In a mean time they grow into higher step corners where many salt steps are bunched. The mechanism is explained by a simple model.

References

- 1) Y. Kitasaki and T. Hata, Nihon Settyaku Kyokai-shi, 8, 131 (1972).
- 2) H. Shindo and M. Ohashi, Appl. Phys. 66A, S487 (1998).