

Specific surface free energy of crucible material and some inorganic crystals

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Contact angle of liquid on solid surface reflects the relationship between the surface tension of the liquid and the specific surface free energy (SSFE) of the solid. Though SSFE of crystal is significant value for theoretical discussion of crystal growth, experimental determination of the SSFE of crystal is not popular, because the reproducibility of the contact angle measurement do not have good reproducibility. Therefore, we tried to measure the contact angle of liquids on a variety of crystals, in order to investigate the origin of the wide distribution of the contact angles of liquid on crystal surface, and concluded that the existence of steps causes the wide distribution the SSFE [1].

Contact angles of sapphire melt on tungsten (W), tungsten-molybdenum alloy (W-Mo), and molybdenum (Mo) test pieces were observed and compared with the SSFE [2]. Bubbles were generated only in the sapphire melt on W test piece. Because of the large contact angle of sapphire melt, bubbles were generated in the sapphire crystal grown in W crucible. The contact angles of water and formamide were also measured at room temperature in order to calculate the SSFE. The SSFEs were calculated. The crucible material with larger SSFE has smaller contact angle of sapphire melt.

Because alkali halide is used as flux for crystal growth, the SSFE of some alkali halide crystal was determined. SSFE of (100) faces of NaCl, KCl, and KBr single crystal was obtained by the contact angle of ethylene glycol and formamide. Dispersion component of SSFE for each crystal was 90-100 mN m⁻¹ and the polar component of the SSFE was 0.5-1.1 mN m⁻¹. Such a large ratio of dispersion component results from the neutrality of the crystal surface. Dispersion and polar component of SSFE were compared with lattice enthalpy: the larger lattice enthalpy decreases dispersion component, and increases polar component. The larger lattice enthalpy is considered to enhance the rumpling of the crystal surface more strongly.

[1] T. Suzuki and M. Oda, J. Cryst. Growth, 318 (2011) 76-78.

[2] T. Suzuki et. al., J. Cryst. Growth, 401 (2014) 508-510.

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