

Specific surface free energy of graphite crystals

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In order to discuss crystal growth, specific free energy (SSFE) is significant value and theoretically well studied. However, the determination of SSFE of solid is difficult. We calculated SSFE of many crystal using contact angle of liquids and discussed the relationships with crystal growth.

Highly oriented pyrolytic graphite(HOPG), grafoil and natural graphite were used as crystal samples. Contact angles of water and formamid were observed using sessile drop method. Crystal faces of HOPG can be classified to edge and plane faces. Contact angle of water on the plane face of HOPG was 79.7 degree, and that of formamid was 68.1 degree. The contact angle of water and formamid on the edge face of HOPG was 59.2 and 52.5 degree, respectively. The contact angle of water on grafoil was observed to be 68.1 degree and that of formamid was 53.4 degree. Contact angle water on the natural graphite showed two peaks, for 76 and 102 degree, but the contact angle of formamid one peak at 53.4 degree.

SSFEs were calculated from contact angle using Wu and Fowkes approximation. Calculated SSFE for plane and edge faces of HOPG were 27.4 and 44.9 mN/m. The SSFE of grafoil was 39.1 mN/m. Two peaks of contact angle of natural graphite were calculated to be 40.6 mN/m(graphite-p), and 79.5 mN/m(graphite-e). The crystal face of natural graphite with lower SSFE was considered to correspond to plane face, and the higher SSFE corresponds to the edge face of graphite.

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