

The effect of chirality of amino acid in solution on the morphology of calcite steps

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Amino acid with chirality has been used as a modifier to understand the mechanism of the D- and L-body separation in the presence of other crystals and to investigate the effects of the chirality of the additives on the shape of growth hillocks or of etch pits. The asymmetrical growth and dissolution steps on the calcite {10-14} face in the presence of chiral amino acid in the solution was reported. The dependence of the effect of supersaturation on the shape of the calcite growth/dissolution steps in the presence of aspartic acid's chirality is unknown so far. Here, recent results on this topic will be reported.

The mm-sized calcite single crystals were prepared by cleaving a larger crystal. All experiments were performed at room temperature under atmospheric PCO_2 . Calcium carbonate solution with the presence of aspartic acid was prepared with calcium chloride reagent, Carbonic acid hydrogen sodium reagent and L- or D- aspartic acid (Wako Co.). The concentrations of calcite and amino acid, from -1 to 3.28 and from 0 to 0.01 mol, here used. The optical methods, Nomarski differential interference contrast microscopy were employed to observe the growth hillocks or etch pits which are composed of mono-molecular steps of calcite, and Michelson interferometer to measure the mono molecular step velocity of calcite. If supersaturation is low, the effect of amino acid on the symmetry of calcite steps was larger and thus the asymmetrical shape of the hillock can be observed. As the supersaturation became higher, the asymmetry became much less. In case of dissolution, if undersaturation is low, the effect of amino acid on the symmetry was larger and thus the asymmetrical etch pit can be seen. As the undersaturation became higher, symmetrical etch pits were observed. In the case of dissolution, the degree of asymmetry is more obvious than in case of growth of calcite.

We therefore suggest a competition model of the step velocity of calcite and the orientation velocity of aspartic acid. In case that the step velocity is high (when supersaturation is high and undersaturation is high), there are not enough time for aspartic acid to orientate a stable direction near the step front and hence asymmetry don't appears. In case that the step velocity is low (when supersaturation and undersaturation are low), there are enough time for aspartic acid to orientate the stable direction near the step front and asymmetry appears.