Micro Structure of the Surface of Sodium Chloride Crystals and its Control

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Summary

We have studied the formation mechanism of liquid inclusions in crystals suspended in a crystallizer. In our previous study, we pointed out that liquid inclusions were formed in a crystal when other crystals adhered to the crystal, suggesting that liquid inclusions are formed by agglomeration. When agglomeration occurs, some mechanical stress may be induced into the crystals due to the mismatch of lattice orientation, etc. Hence, cracks can form on the surface of the crystals. From the cracks, new growth steps are generated. This change in the step pattern causes the formation of liquid inclusions. The most important point is for there to be sufficient energy in the crystal to cause change in the growth step pattern. If this hypothesis is true, we should be able to cause the formation of liquid inclusions by the impact that occurs in a crystallizer. This report describes the effect of contact of a crystal with other solid material (stainless steel rod) on the formation of liquid inclusions.

A stainless steel rod was brought into contact with the surface of a sodium chloride crystal grown in an aqueous solution, and changes in surface structure of the seed crystal caused by making contact several times with the stainless-steel rod were observed under an optical microscope. Contact with the steel rod caused the formation of various-sized cavities in the crystal. The shape of the cavities gradually changed with growth of the seed crystal. After a while, a new growth layer passed over the cavities in the crystal, and the cavities were confined to the seed crystal. Interestingly, the shape of these confined cavities changed with time, indicating the existence of liquid in the cavities. A more interesting change was observed in the surface structure of the non-contact area. Some steps with a very large height (giant step) were formed on the surface by contact. These giant steps moved on the surface but then stopped moving some tens-of-seconds after generation. Some liquid inclusions were formed when the new growth layer passed above the (dead) giant step.

Atomic force microscopic observation showed drastic change in the fine structure of the surface of the crystal due to contact with the steel rod. That is, contact with the steel rod generated a number of steps of various heights (one to one-hundred nano-meters). These new steps developed into the giant step by the bunching mechanism.