edge mechanism" is now a well established technique in the controlled growth of ribbon-shaped semiconductors (Faust and John 1964).

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KINETIC CONSIDERATIONS IN THE GENESIS OF GROWTH TWINNING: A REPLY

THOMAS W. DONNELLY, *Department of Geology, State University of New York, Binghamton, Binghamton, New York.*

Carstens' discussion (1967) of my recent paper on growth twinning (Donnelly, 1967) provides some additional references, largely from the field of metallurgy, including several which I had not seen. I am particularly grateful to him for pointing out that observations of germanium crystals grown from the melt have led to considerations of the importance of orientation of the crystal lattice with respect to the external physical and chemical environment. These considerations, although based on a one-dimensional growth phenomenon, in a highly anisotropic medium are very similar to my own conclusions involving multi-directional growth in an isotropic medium.

However, consideration of some of the other points raised by Carstens provides little enlightenment of the problem. I would take particular issue with Carstens that Fullman's (1957) discussion concerning the relative total energies of twinned and untwinned states of certain hypothetical crystals makes the occurrence of minerals which are dominantly or ubiquitously twinned "more understandable." There are two reasons for my lack of enthusiasm for this approach. Firstly, discussions such as that by Fullman make free use of the term "surface energy" as though this were some fixed value for a particular face of a particular crystal species. This energy in fact depends on the physical and chemical nature of the medium in which the crystal is located, and is not a fixed value. The further fact that the exact nature of the medium in which nearly all natural crystals grew or were subsequently modified is rarely well known makes this energy very difficult for the mineralogist to estimate, and theories based on the necessity of quantification of this energy will be unsatisfying in most cases. One can well appreciate that a crystal with a pronounced anisotropic internal structure is likely to possess the great differences of surface energy that will lead to twinning through the Fullman effect (*e.g.*, probably aragonite), but a wider application of this idea may be dangerous. Secondly, surface energy and what I referred to as attracting the majority of inwardly diffusing materials are very nearly the same thing. The difference between my approach and that of Fullman is that I believe that there may be many cases in which the internal energy of the twin boundary may be an unimportant factor in twin genesis. In the case of the authigenic albite, I find it difficult to believe that the complex, apparently irrational, and areally extensive multi-wedge interface between the twins is anywhere near the lowest energy boundary available. Instead I interpret it as the record of growth competition between the extended host crystal and its twinned overgrowth.

My reasons for minimizing the importance of the re-entrant are that I could not always detect the presence of a re-entrant (my Fig. 1) unfortunately here, shows grains with their boundaries retouched, as the caption indicates. At the very high magnifications involved, I found it impossible to obtain clear photographs of the re-entrants). Also, the twin boundary outcrop on faces *c* and *p*, as I indicated, appeared to be roughened, and I interpreted this as the effect of local solution.

The importance of screw dislocations is not easy to evaluate. In my paper I limited my comments on screw dislocation to the supposition that it might be important in some cases. In the case of authigenic albite, whose growth stages can be observed, screw dislocation would be very difficult to postulate. In any event, the torsion across a twin boundary, which might, for example, serve as a generating mechanism for growth twins in all of the so-called parallel and complex twin laws of volcanic feldspars, would be absent across a reflection twin boundary, such as that of albite twinning.

The factors that must be considered in any discussion of crystal growth or growth twinning are many, and their mutual evaluation is not easy through purely theoretical approaches. A theory can tell us if a certain factor ought to be important, but it can rarely tell us if this factor is more important than other factors. Theories that require the evaluation of twin boundary energies are forced to remain qualitative, for the most part, simply because these energies, even for crystals of rather simple, symmetrical structures, and possessing almost purely ionic bonding, are difficult to calculate. The calculation of the twin boundary energy for a feldspar, on the other hand, will be a formidable task. In a few cases, observations of certain crystals show that certain factors are important in these cases, and that other factors were of considerably less importance. There is no such thing as the importance of any one factor for all growth or twinning.

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UNIT-CELL PARAMETERS OF THE MICROCLINE-LOW ALBITE AND THE SANIDINE-HIGH ALBITE SOLID SOLUTION SERIES: A CORRECTION

PHILIP M. ORVILLE, *Yale University, New Haven, Connecticut.*

The entropy of disordering for the low- to high-albite transition calculated on page 71 of the above paper is too small by a factor of four. This incorrect value for ΔS was then used to calculate the effect of pressure on the low-high albite transition by means of the Clausius-Clapeyron equation. I am grateful to Dr. R. G. J. Strens of the University of Leeds for drawing my attention to this error.

The corrected lines are given below and should be substituted for lines 8–12 on page 71 and lines 1–5 on page 72.

The entropy change for the transition will be largely due to disordering one Al and three Si cations over four tetrahedral sites which is

$$\begin{aligned}\Delta S &= -4R(1/4 \ln 1/4 + 3/4 \ln 3/4) = 4.48 \text{ cal deg}^{-1} \text{ mole}^{-1} \\ &= 188 \text{ cm}^3 \text{ bar deg}^{-1} \text{ mole}^{-1}\end{aligned}$$