

# ON THE QUESTION OF THE MECHANISM OF DENDRITIC GROWTH OF CRYSTALS WITH THE DIAMOND STRUCTURE

CRYSTALLOGRAPHY

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**Abstract****Full Text**

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CRYSTALLOGRAPHY

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**ON THE QUESTION OF THE MECHANISM OF DENDRITIC GROWTH OF CRYSTALS WITH THE DIAMOND STRUCTURE***(Presented by Academician N. P. Sazhin, 20 III 1967)*

The core of a germanium dendrite  $\langle 112 \rangle$  with one twin plane crystallizes in a form, unusual for crystals with the diamond structure, of a pure tetrahedron. This is easily detected when the growing crystal is torn away from the melt and was shown in a number of works (<sup>1-3</sup>). New observations allow us to illuminate more fully the questions of the growth of these crystals, including also dendrites with a more complex twin structure.

Below are given two microphotographs: of the transverse section of a dendrite with one twin plane (Fig. 1) and of the transverse section of a dendrite with two twin planes (Fig. 2).

Comparing the photographs, we may conclude that the structure of the core in both dendrites is exactly the same. Consequently, the growth of both dendrites obeys the same mechanism. The development of the core begins from a central point lying on the twin plane and spreads from there in the form of a series of concentric rhombi, the sides of which correspond to the traces of emergence of four  $\{111\}$  planes bounding the core in the form of a tetrahedral pyramid formed by two twinned tetrahedra (cf. (<sup>3</sup>)). The calculated value of the acute angle of the rhombi is  $44^{\circ}20'$ . Measurements confirm this.

The tetrahedral structure of the  $\langle 112 \rangle$  core, represented most perfectly in a single-twin dendrite, was invariably observed in all the numerous two- and three-twin dendrites investigated by us.

In connection with the foregoing, we believe that the concept of the reentrant angle, advanced (<sup>1,2</sup>) in application to dendrites with the diamond structure, and based on the octahedral growth model, is not confirmed by the actual growth patterns (Figs. 1 and 2).

Tetrahedral growth forms have repeatedly been observed for diamond itself. Twinning is usually associated with them. Various judgments have been expressed concerning the appearance of such diamond forms. The reasons, how-

ever, remain unclear to the present time. A review of information concerning these diamond forms may be found in I. I. Shafranovskii (<sup>4</sup>).

Similar behavior is exhibited by crystals of compounds with the ZnS structure, which under normal conditions crystallize, owing to the chemical difference of the atoms A and B making up these compounds, either in a tetrahedron with external planes made of B atoms, or in an octahedron, but again with preferential development of faces made of B atoms.

In the diamond lattice only one kind of atom is present. The explanation of the unusual behavior in this case may lie in the fact that one of the faces of the tetrahedron in diamond crystals and its analogues is represented by a twin plane, on which the atoms, in their physical state, differ from the basic atoms in the lattice.

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**Fig. 1.** Microphotograph of a transverse section of a  $\langle 112 \rangle$  dendrite with one twin plane. Etching CP-4; 70°C. 100×

**Fig. 2.** Microphotograph of a transverse section of a  $\langle 112 \rangle$  dendrite with two twin planes. Distance between the twin planes 32  $\mu$ . Etching CP-4; 70°C. 250×

*Note: Figure translations are in progress. See original paper for figures.*

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