The Growth and Morphology of Diamond Crystals

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X-ray diffraction topography has shown that natural diamonds grow by three different modes: (1) Faceted growth on octahedral {111} planes, producing octahedral crystals; (2) Cuboid growth on curved crinkly surfaces of mean orientation {100}, producing crystals of cubic shape; and (3) Fibrous (columnar) growth along <111> directions which, with fibre branching, also produces crystals of cubic shape. In mode (3) the diamonds are often coloured by impurities incorporated during growth.

Many diamonds show combinations of growth: simultaneous (1) + (2) growth can produce complicated morphologies; (1) followed by (3) produces so-called 'coated stones' with pseudo-dodecahedral {110} facets; and (3) followed by (2) again produces cubes. Most diamonds also show dissolution, to greater or lesser extents, at the end of their growth histories. In severe cases, octahedral diamonds become rounded dodecahedra, and cubic diamonds become deeply pitted.

Twinning in growth modes (1) and (3) is observed, producing spinel-type 'macles' and fluorite-type interpenetrant cubes respectively. Twinning on more than one {111} plane can produce complicated morphologies, as well as rare tetrahedra. The latter may also arise from {111} cleavage. The tetrahedron is not true a growth form: the existence of tetrahedral diamonds does not compromise the accepted symmetry of the diamond structure.

Some comparisons and contrasts with the high-pressure/high-temperature growth of synthetic diamonds can be made.

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