Representations of Cubic Crystal Structures by a Collection of Polyhedra

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The packing of Archimedean truncated octahedra fills the entire space. This Wigner-Seitz cell for an fcc type cubic lattice has been shown to be a useful geometric unit for all cubic crystal structures (C. Chieh, Acta Cryst. A35, 946-952 (1979)). The application of this concept has been demonstrated for structures whose geometric units possess 43m symmetry (C. Chieh, Acta Cryst. A35, 819-826 (1980)). All geometric units for structures in 43m and Pm3m and two out of the three units in Pm3 possess m3m symmetry. Structures in these units can be represented by a set of polyhedra taken from any combination of octahedron, cube, icosahedron, truncated octahedron, truncated cube and rhombo-cuboctahedron. An interesting relationship between these polyhedra and the Archimedean truncated octahedron will be shown with models.

A comparison of polyhedra present in various isomorphous space groups will be made and applications of the geometric units for the representation of non-isomorphous space groups will be demonstrated. Results from further exploration of Wigner-Seitz cells as possible geometric units in hexagonal and tetragonal systems will be presented.

Defect Distributions in Various Polytypes of Silicon Carbide


Since the discovery of polytypic structures in 1965 numerous theories have been proposed to explain their existence. So single theory has so far been in complete agreement with all the experimentally observed data. The screw dislocation theory by Frank (Phil. Mag. (1951) 42 p.1014) and later by Mitchell (Z. Kristallgeogr. Kristallgeom. (1957) 102 pt 1 p.341), Krishna and Verma (Z. Kristallgeogr. Kristallgeom. (1963) 121 p.96) and Pandey and Krishna (Phil. Mag. (1975) 31 p.1113), J. Crystal Growth (1975) 36 p.267, Nat. Sci. Eng. (1975) 36 p.267, (1976) 36 p.267) has correlated quite well with observation but the origin of the dislocations has remained open to question. Recently Kuhlmann-Wilsdorf, Pandey and Krishna (Phil. Mag. (1980) 42 p.527) have proposed a model in which impurity content and subsequent stress gradients could give rise to slip or buckling or both.

We are using X-ray methods, in particular X-ray topography, and electron microscopy to examine a large number of 6H SiC platelets which were grown from the vapour phase. In this way, we are able to assess the impurity content and defect distribution in each crystal. Work is continuing but preliminary results show that buckling is quite common with radii of curvature being in the region of 4 to 5 metres.

Many samples show evidence of the basal slip system being active in agreement with earlier observations by Posen and Bruce (Proc. 3rd Int. Conf. on SIC, Miami Beach, Florida 17-20 Sept 1973, p.236). Stacking faults parallel to the basal plane have also been found.

Defect distributions in different polytypes are compared and of particular interest are crystals containing more than one polytype. It is expected that this information will be useful in improving our understanding of the growth mechanisms operating during growth of polytypic materials.