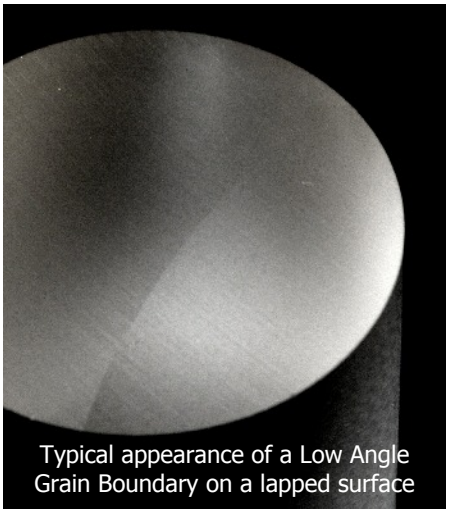
SINGLE CRYSTALS & GRAIN STRUCTURE

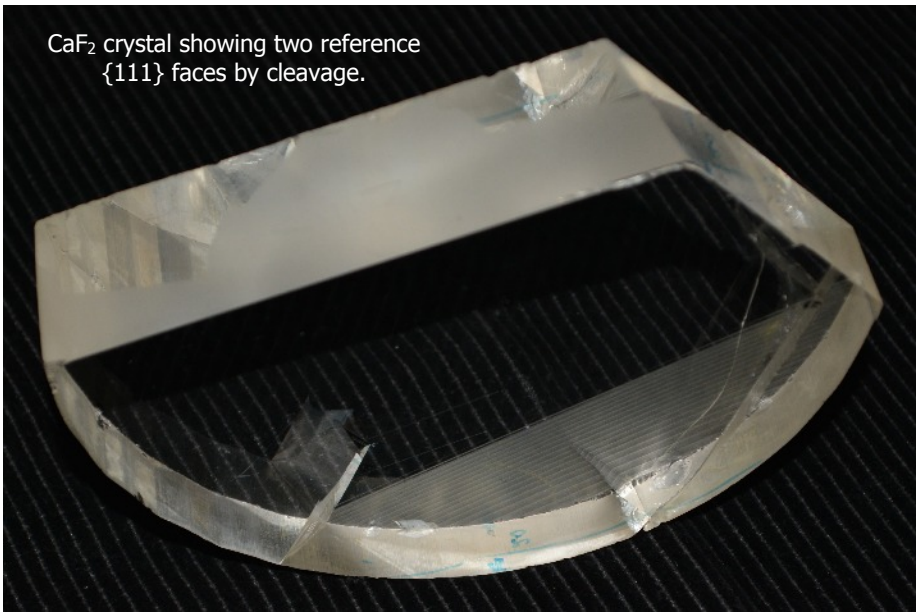
Large cubic crystals of fluorides are not seeded on any particular crystal orientation. This is not a difficulty in normal use. The bulk crystals often contain one or two grain boundaries and so it is sometimes difficult to select larger pieces strictly as single crystal. The supplied blank may include a low-angle grain boundary. This is not a weak point and will become invisible on polishing not even detectable in the interferogram of the finished optic. It will not cleave. Crystran will guarantee its integrity during normal working.

The definition of 'low angle' boundaries is not simply a matter of angle, but more about the dislocation of the lattice at the boundary. Typically though there is a maximum value of about 4° tilting between adjacent crystal grains where the two grains share common lattice points before lattice strain dominates. The grain boundary can be thought of as a row of dislocations. Consider also that a perfect single crystal is an impossibility, even within a 'single' grain, there will be a huge number of dislocations and lattice defects.

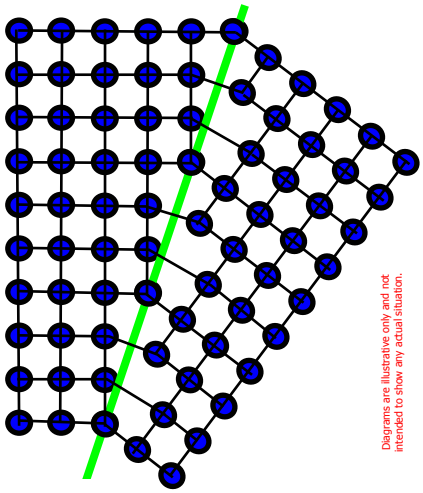
At higher angles, the lattice cannot compensate and deformation rather than dislocation makes for a weaker join; a high angle grain boundary. It is then more common that the crystal cracks along this line or the boundary opens up because of higher built-in strain.



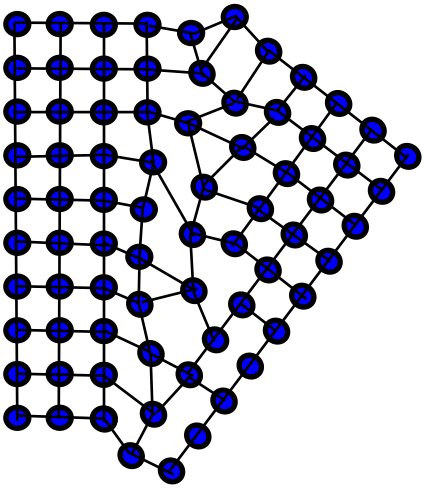
Typical appearance of a Low Angle Grain Boundary on a lapped surface



CaF_2 crystal showing two reference {111} faces by cleavage.



Low Angle Grain Boundary Structure.
Note the shared atoms along the division line.



High Angle Grain Boundary Structure.
Note the distorted lattice at the division.

CaF_2, BaF_2 and SrF_2 are cubic crystals and with some skill can be cleaved on the {111}. The CaF_2 here has been cleaved to show two of the planes which form part of a tetrahedron. Note that they are randomly aligned with the grown crystal diameter. If it is an absolute requirement, these planes can be used as reference to supply oriented single crystal pieces. This is only important where lattice effects are inherent to the final product.

LiF which cleaves more easily on the {100} is more often required as oriented single crystal.

MgF_2 is not cubic and exhibits bifrefringence. It does not cleave on any recognised planes and must be seeded in growth and thus is always aligned optically. It is always supplied without grain boundaries and with reference to the optical axis.

This information represents the best of our understanding at present, it is for guidance and is not intended to be comprehensive. Crystran Ltd cannot be responsible for any problems caused by wrongly specified material as a result of using this data sheet. Suitability of material for purpose must always be confirmed at point of ordering.

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