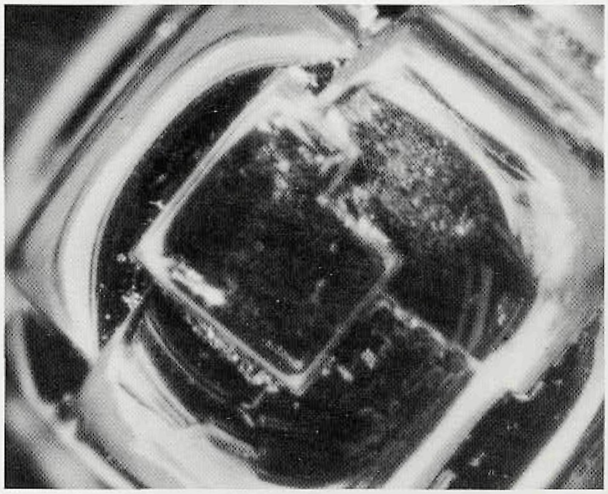
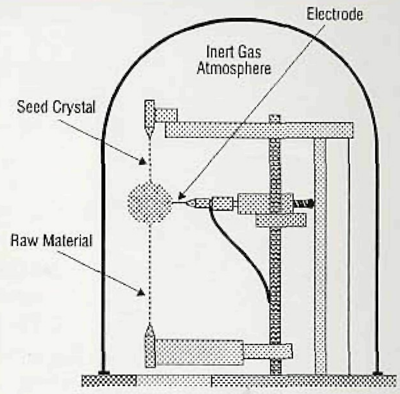
The Making of LaB_6 Crystals

Damon L. Heer, FEI Company

The following image is of a LaB_6 crystal formation created at the FEI Company, Hillsboro, Oregon. The photograph was taken through a Bausch & Lomb Stereo Zoom 4 at 30X with a Polaroid MicroCam.



The single crystal LaB_6 and CeB_6 is grown and fabricated at FEI using a well-defined process known as "Inert Gas Arc Float Zone Refining." This process takes place in an inert gas atmosphere and utilizes an electrical arc to melt the hot, pressed powder sample of LaB_6 or CeB_6. This not only allows the growth of the crystal, but also helps to purify the material. Through research and 20 years of experience in the growth of rare-earth boride single crystals, FEI can carefully control the material composition (e.g. stoichiometry of B/La) for the highest possible ratio of electron emission to evaporation rate.



The LaB_6 formation shown at left is a controllable artifact that is formed at the very end of a zone refining run. The formation is created when the refined crystal above the electrode separates from the raw material below the electrode.

Features result from the re-crystallization of the molten rod below the separation point. The effect depends on the way in which the molten zone is separated and on the cooling rate. The method of separation determines the amount of material that makes up the molten volume. In practice this depends on how fast the electrode is shut off and the raw and refined material is pulled apart.

Surface tension favors a spherical shape when gravity is not significant, but if too much mass is on the molten volume, then gravity will tend to widen and flatten it - hence, the quasi-spherical or hemispherical effect. The cooling rate then determines how long impurities have to diffuse out of the hot (but cooling) LaB_6 and the state of the equilibrium shape when it has finally frozen. The rate of cooling determines the size of the polycrystals or grains. Polycrystal is generally a higher energy state than single crystal. So if the material cools quickly, it's likely to be polycrystal. If the material cools slowly, the result is anything from polycrystal with large grain sizes to single crystal, a lower energy state.

The hot end near the separation point takes longer to cool and the end form is a competition between the cooling, recrystallizing pure material that existed above the separation point, and the more quickly cooling, impure material below the separation point. If the top 'cleaner" material has long enough to grow, it will attempt to form the LaB_6 <100> planes. Because it is impure though, it will have many types of flaws and defects, some which produce terraces and steps as seen in the photograph. ■

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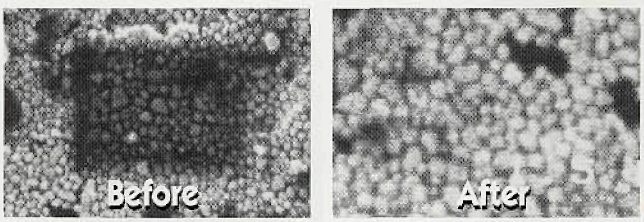

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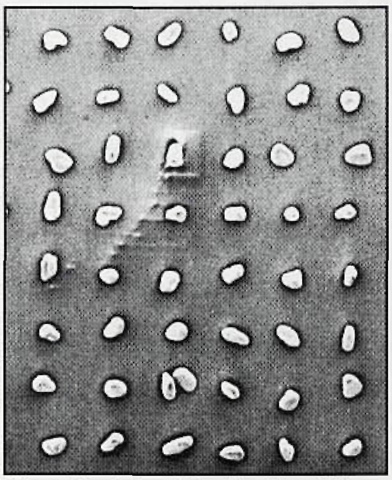

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Note: The Tacky Dot technology, U.S. Patent no. 5,356,751, is intended for use in microscopy laboratories. Our license to supply this technology to you does not extend beyond applications in microscopy.

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- the ease with which particles can be identified by coordinates and examined by multiple techniques.
- the ease in determining average weight of single particles.

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100µm	1,000µm	02389-BA	02389-MB	02389-RA
150µm	1,000µm	02390-BA	02390-MB	02390-RA
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