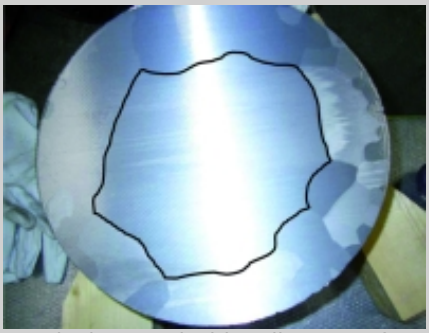
From DESY inForm: An idea takes shape: New production technique in view for niobium cavities

In the development of superconducting cavities for the ILC, the machine planning group (MPL) lands another success. New prototypes manufactured from a so-called niobium single crystal plate yield excellent results. The advantage of single-crystal cavities compared with standard ones made of polycrystalline niobium lies in the atomic structure of the crystal lattice.

Polycrystalline metal has a lattice that is not always arrayed regularly, leading to sharp edges and unequal orientations in the crystal grid. These ruptures, called grain boundaries, basically reduce the performance of a cavity.



Single crystal with a diameter of 20 centimetres—scientists are only satisfied with a diameter of 26,5 centimetres.

A single crystal does not have grain boundaries. All niobium atoms rest in a homogeneous, regularly arrayed layer of the crystal lattice. In collaboration with the manufacturer ACCEL, DESY scientists succeeded in building a single-cell 1.3-gigahertz cavity from a single niobium crystal. In test runs it reached acceleration gradients of about 38 megavolts per meter. The MPL group is now confidently planning a first nine-cell cavity. Since it is currently impossible to produce the sufficient amount of large niobium single crystals, smaller but thicker single crystal plates have to be rolled out and moulded to a half cell; subsequently, two of them are welded together. The trick is to avoid grain boundaries even at the welding seam by taking care that the identical orientation of the niobium atoms is maintained- thus the entire cavity cell consists of one single crystal.

Only recently, the joint DESY/ACCEL invention has obtained the decision to grant a patent for this production technique.

-- Sandra Hesping, DESY

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