

July 14, 2015

**Launching High-purity Niobium Material for Superconducting Accelerators**

**ULVAC, Inc.**

ULVAC, Inc. (Headquarters: Chigasaki, Kanagawa; President and CEO: Hisaharu Obinata; hereafter referred to as ULVAC) announces that it has developed niobium material of high purity for superconducting accelerators and will start selling the material in July.

**【Background】**

Superconducting accelerators are expected to be used in a wide variety of areas, including researching the origin of the universe by International Linear Colliders (ILC) in particle physics, analyzing the structure of proteins in medicine, and partitioning and transmuting of high-level radioactive waste using nuclear transmutation (ADS : Accelerator Driven System) in environmental and energy sciences.

Superconducting accelerators are used to accelerate charged particles (such as electrons, positrons, protons and ionized atoms). Niobium (Nb), which becomes superconductive at the highest temperature (9.25 K) among pure metals, is used as material for accelerating cavities. Niobium material for accelerating cavities must have a Residual Resistance Ratio (RRR) that exceeds 250.

\* RRR: An index of material purity, which is calculated as a ratio of electrical resistivity at room temperature to electrical resistivity above the superconductivity transition temperature ( $T_c$ )—the larger the RRR of a material, the higher its purity.

**【Technology overview】**

To increase the purity of niobium, ULVAC optimized multiple conditions, including the selection of raw materials, the degree of vacuum, and melting speed by using a 600 kW EB melting furnace that was newly constructed at our group company ULVAC Tohoku, Inc. (Hachinohe, Aomori), thereby successfully producing niobium ingots with an RRR exceeding 250.

We requested the High Energy Accelerator Research Organization (KEK)—an inter-university research institution with which we conduct joint research—to manufacture a single-cell accelerating cavity by using plates produced from these ingots and to conduct an electric field performance test. Consequently, we achieved a maximum accelerating electric field gradient of 41 MV/m (performance required for ILCs: at least 35 MV/m).

**【Characteristics】**

1. High-purity niobium ingots with an RRR exceeding 250 manufactured at ULVAC's in-house facilities
2. Material with an electric field gradient of 41 MV/m
3. Integrated production of plates, bars, and tubes from niobium ingots
4. Seamless tubes and other processed products also available

**【Outlook going forward】**

At present, accelerating cavities are manufactured by press-molding niobium plates into cup-shaped parts and welding the parts by electron beams. However, there is concern over a decrease in yield resulting from welding defects, etc. as well as over a decline in acceleration performance caused by welding beads inside cavities. To resolve these issues, we are conducting joint research and development with KEK on producing accelerating cavities from seamless niobium tubes. Manufacturing seamless niobium tubes and then bulge-molding the tubes (hydraulic molding: a molding method that places tube-shaped material in a metal mold within a sealed device and imposes high pressure on liquid injected inside the tube to bulge the material into the shape of the mold) will significantly reduce the need for welding, thereby increasing yields as well as avoiding a decline in acceleration performance. By applying this technology, ULVAC will continue making new proposals to meet customer needs with niobium material for superconducting accelerators.

**【Photo and graph】**

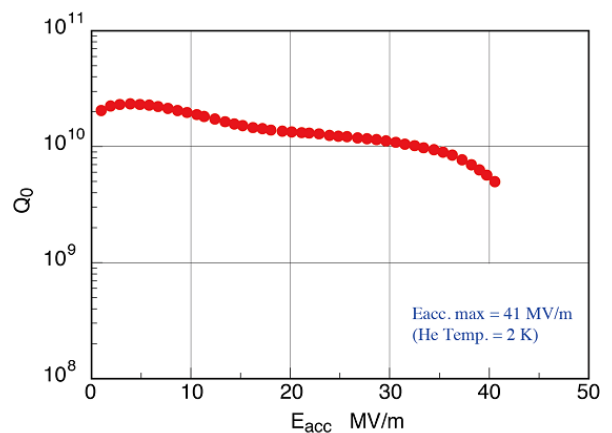


Photo: Single-cell accelerating cavity manufactured by KEK from ULVAC's material

Graph: Electric field performance of a single-cell accelerating cavity made from ULVAC's material

Contact information

ULVAC, Inc.  
Material Division  
Noriyuki Abe  
TEL: 81-475-89-0246 / FAX:81-475-89-1392

Website

[http://www.ulvac.co.jp/products\\_e/](http://www.ulvac.co.jp/products_e/)  
<http://www.ulvac.co.jp/>