Equipment Development Center

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Design and fabrication including the research and developments of the new instruments necessary for the molecular science are the mission of this center, which consists of the mechanical, electronics and glass work sections.

We expanded our service to the outside researchers of universities and research institutes since 2005. The main aims of this new attempt are to contribute to the molecular science community and to improve the technology level of the center staffs.

The technical staff of the Equipment Development Center is engaged in planning, researching, designing and constructing high technology experimental instruments in collaboration with the scientific staff. And these experimental instruments are manufactured by incorporating with new technologies and new mechanical ideas. A part of our activity in the current fiscal year is described below.

Fabrication of a Micro Channel for a Micro Mixer

The micro mixer is a powerful apparatus that enables us to mix liquids efficiently in the micro channels as small as tens of micrometer. However, the products obtained by the mixer are sometimes contaminated by unwanted chemical reactions between the liquid and the base metal since the most of the micro mixers commercially available are made of metal. In order to prevent this, fabrication of a mixer made of a glass is required which is a technical challenge.

At the start of the project, we decided to fabricate the micro mixer by metal in order to optimize the dimensions and geometries of the micro mixer. We made micro channel of brass as shown in Figure 1 by using NC milling machine with minute end mill. The thickness of a channel wall and the distance between the channels are 100 micrometer. The channel depth is estimated to be 100 micrometer by considering the effective cutting length of an end mill used. The micro mixer we designed and fabricated consists of three parts, as shown in Figure 2.

Test experiment showed that efficiency of the mixing was not satisfactory; the results of the mixing were nearly the same with those obtained by conventional mixing. Although the reason is not clear at this moment, we believe that this is due to the fact that the wall thickness is too large. Then, we are now making an effort to reduce the wall thickness by using an end mill with a spherical shape.

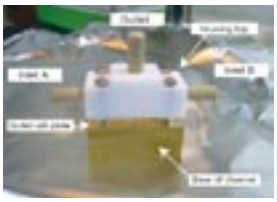

Figure 1. Micro mixer outline view.

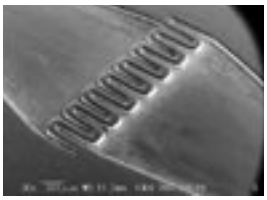

Figure 2. Micro channel.

Manufacture of the Stainless Steel Electrode Parts Using the Elliptical Vibration Cutting Method

To suppress the field emission dark current of various electron guns by high electric field sufficiently, it is required that the surface of the electrode is mirror-finish and Rz value is less than 0.1 micrometer. Titanium, molybdenum, and stainless steel are used as composition components. Currently the mirror-finish is attained by polishing. Therefore the discharge is induced by the abrasive grain remained on the surface. We applied the elliptical vibration cutting method to get a mirror-finish only by cutting those parts.

The elliptical vibration cutting method is the technique which Professor Shamoto of Nagoya University developed. The validity of this technique clarified by the ultra-precision machining using the diamond turning tool of the material, which was impossible due to the problem of a tool life until now.

Figure 3. The 28mm diameter, surface-of-a-sphere with R60mm made by sending speed 10 micrometer/rev, spindle rotation speed 20 rpm, the vibration radius 2 micrometers and vibration frequency 39 kHz.

Figure 3 shows photograph of the SUS304 material surface-of-a-sphere made by the elliptical vibration cutting. The best Rz value of the mirror-finished surface is 0.025 micrometer.