Equipment Development Center

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Researches and developments of novel instruments demanded in the forefront of molecular science, including their design and fabrication, are the missions of this center. Technical staffs in the three work sections, mechanics, electronics and glass works are engaged in developing state-of-the-art experimental instruments, in collaboration with scientists. We expanded our service to other universities and research institutes since 2005, to contribute to the molecular science community and to improve the technology level of the center staffs. A few selected examples of our recent developments are described below.

Fabrication of Ellipsoidal Reflector for Inverse Photoelectron Spectroscopy

We have successfully fabricated the Ellipsoidal Reflector for Inverse Photoelectron Spectroscopy as shown in Figure 1. The surface of this mirror should have a form accuracy of 1 μm and high precision a roughness of 10 nm, because it is used for collecting ultraviolet light. For a fabrication with a lower precision level, a CNC Turning Center or Machining Center is used. After the machining, mirror surface with less than R_a 100 μm surface roughness is obtained by hand lapping. However, in this case, a high precision machining is needed. So we fabricated it using the High Precision Turning Machine at National Astronomical Observatory of Japan. The mirror has an asymmetric structure with some holes, which are used to set samples and irradiate electron beam. It was expected that this structure would cause a vibration during the machining and consequently degradations of the form accuracy and the surface state. To avoid this, we worked with an extremely low rotation speed. As a result, the mirror surface with a roughness of R_a 5.8 nm could be successfully obtained as shown in Figure 2.

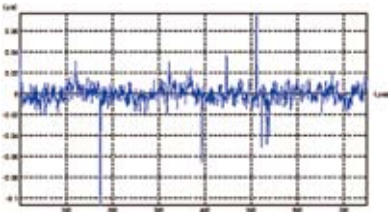

Figure 2. Surface roughness of Ellipsoidal Reflector measured with Laser Probe 3D Measuring Instrument.

Development of Two-Step High Voltage Pulse Generator with the Fast Rise Time

We have developed a two-step high voltage pulse generator having nanoseconds rise time, which is required for the generation of electric fields in time-of-flight mass spectrometry measurements. Figure 3 shows the simplified circuit schematic of the design. The pulse generator is composed of two set of adjustable high voltage power supply and high speed, high voltage switch. The control signals for these high voltage switches are derived from two monostable multivibrator circuits. The apparatus provides a negative step pulse with maximum amplitude of –500 V and a positive step pulse with maximum amplitude of 4.5 kV continuously. The negative pulse width is adjustable from 650 ns to 6 μs, and the positive pulse width is variable from 5 μs to 50 μs. A typical output voltage pulse waveform is shown in Figure 4.

Figure 1. Ellipsoidal Reflector for Inverse Photoelectron Spectroscopy.

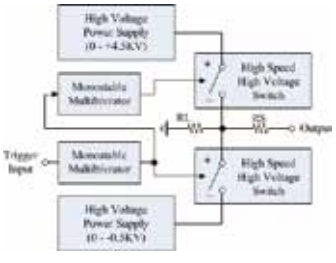

Figure 3. Circuit schematic of the two-step high voltage pulse generator.

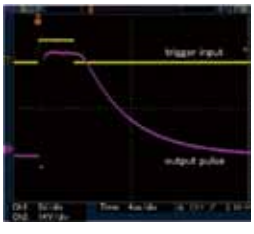

Figure 4. Input and Output pulse waveform.