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 two work sections, mechanics and electronics, 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.

ARM-Microcontroller-Based Rotary Solenoid Driver

WA laser-shutter device, which can block a laser beam synchronizing with external control signals as trigger, is one of the basic elements in optical systems. In this work, we have developed a driver unit to control a shutter device, which consists of a bi-stable rotary-solenoid and a shutter plate, operated with TTL level trigger at a repetition rate up to 10 Hz (Figure 1).

Specifications of the driver are as follows: First, it detects the rising edge of the trigger, then, generates a Phase-A output to drive the rotary solenoid clockwise with a predetermined duration. Next, it detects the falling edge of the trigger, and generates a Phase-B output to drive the solenoid counter-clockwise with a predetermined duration. The tunable ranges of Phase-A and -B durations are from 1 ms to 99 ms with the step of 1 ms.

Conventionally, we used a combination of standard logic ICs for driving a circuit synchronized with a trigger. In this case, we adopted the module of LPC1114FBD48/302, the ARM microcontroller by NXP. We set one of the pins of ARM module as an input, and set interrupts on both edges of the trigger (rising and falling). ARM module identifies rising or falling edge in the interrupt handler, and outputs Phase A or Phase B. (Figure 2).

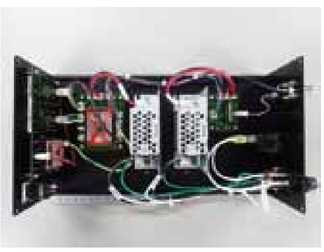

Figure 1. Photo of the rotary solenoid driver.

The duration of the each output is adjustable with a rotary encoder which is connected to the ARM module. Increasing or decreasing of the value is performed by detecting the rotation direction of the rotary encoder. The value is displayed on a LCD by another ARM module. We adopted I2C for communication between two ARM modules.

Figure 2. The input–output characteristics of the rotary solenoid driver.

Cathode Plug for Superconducting Electron Emitter

A new electron source is required for the development of next generation synchrotron radiation system. A cathode plug that will be used for photo-cathode with back-side irradiation has been fabricated (Figure 3). The plug is designed to be able to hold a photo-cathode substrate on the top, and can be fixed with screw on the cathode holder. The photo-cathode substrate, whose size is 5 × 5 × 0.5 mm^3, is requested to stay in the same plane with the plug's top-edge plane, and therefore cannot be fixed by using a holding plate mounting on it. At the same time, fixing of the substrate by side-holding makes it bending and inclining, which arises another undesirable problems. In order to address these issues, we have designed a new substrate-holding cathode plug with elastic parallel hinge structure. The tightness of the hinge was optimized to meet the best result of finite-element-method calculation by ANSYS program (Figure 4), so that accurate fixing of photo-cathode substrate has finally been achieved.

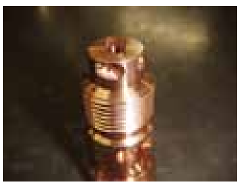

Figure 3. Cathode plug for electron emission.

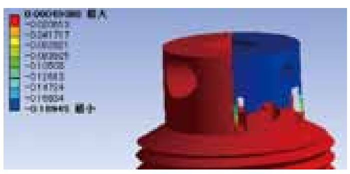

Figure 4. Analysis result for the elastic hinge calculated by ANSYS.