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.

Development of Seven-Axes Adjustable Stage for Manufacturing of Multi-Channel Biosensor

We are developing fine processing technologies using photo-fabrication as a new supporting technology.

We process penetrated micro-holes of about 1 to 2 µm in diameter with X-ray lithography at the specific positions on PMMA (poly-methyl-methacrylate) boards which are used for researches of biosensors, such as transferring signal of nerve cells, and so on.

We have developed a seven-axes adjustable stage for the alignment of the X-ray mask and the PMMA board accurately and conveniently. The positioning accuracy of less than 10 µm was succcessfully demonstrated.

Figure 1. Seven axes adjustable stage.

Development of Microfluidic Mixer for Research of Structural Changes in Proteins

We are developing a microfluidic mixer, which is used to investigate structural changes in proteins by mixing of two or more solutions combining with a fluorescence microscope. This is another example of the application of the photo-fabrication.

For this device, we have to produce micro-flow-channels of 10 µm width and 50 µm depth. Since it is hard to produce by ordinary machining, we have been developing techniques based on photolithography and PDMS (poly-dimethyl-siloxane) molding. We have successfully produced a microfluidic mixser as shown in Figure 2.

Figure 2. Microfluidic mixer.

BPM System Using Coaxial Switches and ARM Microcontroller through LAN

For the commissioning work after the remodeling of the UVSOR electron storage ring, which started from April 2012, we have developed a beam position monitor (BPM) system, which is capable of measuring the electron beam orbit, turn by turn. The sensor head of BPM consists of four electrodes mounted on the beam pipe. The beam position can be deduced from the difference between the induced fast electric pulse voltages on the electrodes by the beam. The electric signals are recorded by a digital oscilloscope which has four channels. The key technique of the system is switching of the BPM signals remotely from control room.

In UVSOR, there are 24 BPM heads. By using the newly developed signal switching system (Figure 3), we can select one BPM head (four signals) from 8 BPM heads. Coaxial switches of 16 SPDT types and 4 SP4T types are used. (Figure 4)

Figure 3. BPM system.

We control totally 20 coaxial switches by ‘mbed,’ the ARM microcontroller development kit. The control application is configured in a HTML file and JavaScript library, which can handle multiple I/O ports. The ‘mbed’ responds as a HTTP server when we access from LAN, and the control application is displayed on the Web browser, which enables us to select remotely the BPM signals.

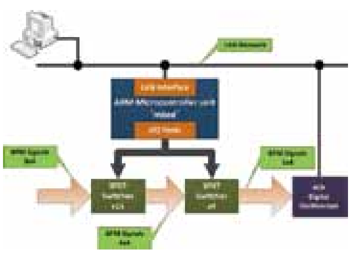

Figure 4. Block diagram of BPM system.