Equipment Development Center

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Research and development 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 lithography 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.

PDMS Mixing Chamber for Soft X-Ray Absorption Spectroscopy

We have fabricated a microfluidic device with flow paths for solution mixing, which is used for soft X-ray absorption spectroscopy. This flow device is equipped with two inclined channel paths which guide liquids to a mixing chamber in addition to a channel for outcoming flow. Width and depth of the flow paths are both 50 μm, and the pattern seen from above is Y-shaped. The diameters of the channels are 0.2 mm, and the bottom of the device is made of SiN membrane. We have produced these flow paths by casting PDMS (polydimethylsiloxane) into a mold. We have made the inclined channel paths by embedding three piano wires with a diameter of 0.2 mm before curing PDMS moiety (Figure 1). We have fixed these wires by using a guide produced by 3D printer. Since some issues have been found in the experiment, we are planning to improve this device.

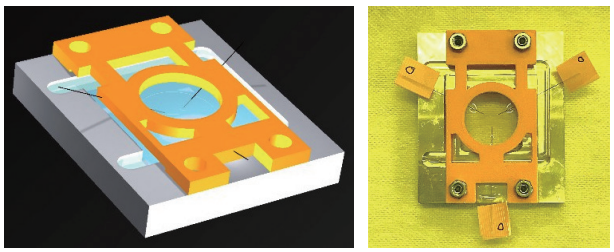

Figure 1. A 3D drawing (left) and picture (right) of the PDMS sample holder in a mold.

Improvement of ECL Logic Circuit with CPLD and Development of an Analog Level Converter

We have developed “a multi-coincidence electronic circuit for time-resolved reaction microscopy of electron Compton scattering” in collaboration with Institute of Multidisciplinary Research for Advanced Materials, Tohoku University, in 2007. The circuit consists of many devices for emitter coupled logic (ECL) to process multiple signals transmitted from position-sensitive-detectors (PSDs).

We have received a request to improve the circuit for higher performance in another experiment. It requires a circuit to accept 13 inputs to be processed into one output signal in Nuclear Instruments Module (NIM) level. Pulse duration of input signals should be stretched using a monostable multivibrator. The output signal is generated by several logical operations. To simplify implementation of such operations, we decided to use CPLD (Complex Programmable Logic Device; XC2C256-7TQ144C by Xilinx) with analog level transducer circuit (Figure 2). All of logical operations are putted into single CPLD and tested by simulation. Level converter circuit that we have developed can convert NIM level pulses into TTL level in a 10 nanoseconds duration time scale (and vice versa) as we expected. We are planning to test them with a virtual system that reproduces the real experimental setup.

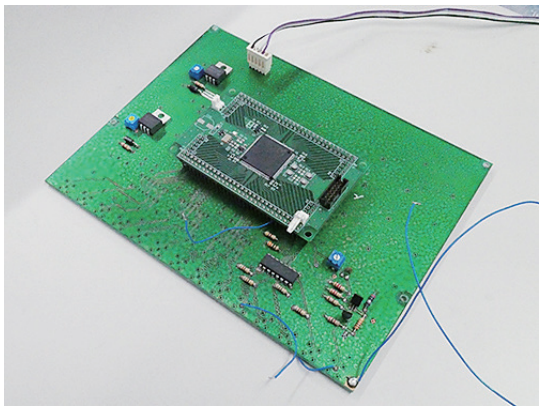

Figure 2. Level conversion circuit and CPLD board assembled for the performance evaluation.