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.

Introduction of 3D Printer

We have introduced a fused deposition modeling (FDM) type 3D printer, and started production of molecule models, such as proteins.

The model structures are based on a PDB file which includes the coordinate data of protein atoms. We convert it to the STL file, which is the collection of triangles for 3D printer, in a careful manner so that the printer can generate the 3D structure in an appropriate precision. After printing, finishing process of the model is completed through a lot of steps such as removal of supports, surface treatments, and coloring. Now we can produce fairly large and complex models. (Figure 1)

In addition, we utilize the 3D printer in the trial of designing and manufacturing. In the design phase, we can confirm the shape and movement of a given equipment by producing a prototype model with 3D printer. Model structure provided by 3D printer is of a great help for communication with a client. Furthermore, it also provides a short cut to produce high quality equipment in fewer steps. (Figure 2)

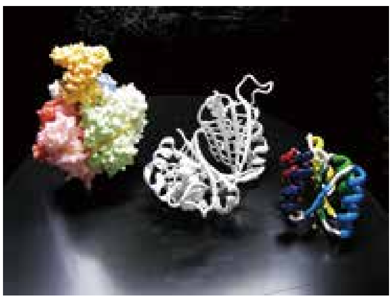

Figure 1. Structural Models of proteins.

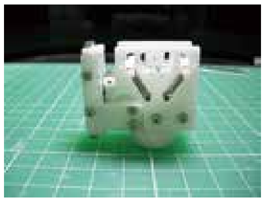

Figure 2. Prototype model of the equipment for crystal bending generated by 3D printer.

CPLD and ARM-Microcontroller-Based TTL Level Double Pulse Generator

In the analyses of chemical reaction processes using irradiation of a laser to molecules, we need to control the measurement apparatus and to open its gate in a short period of time whose duration is defined by predetermined delay time and pulse width, with synchronization to the pump laser. We have developed the TTL level double pulse generator (Figure 3) for this purpose. The main specification of this generator is shown in Table 1. This generator is made of CPLD (Complex Programmable Logic Device; EPM570T100C5N by Altera) and ARM® microcontroller (LPC1114FBD48/302 by NXP).

CPLD generates the delay pulse synchronized to trigger input. Then it generates logical disjunction of the delay pulse and the trigger pulse, with an interface operated by ARM microcontroller. More precisely, CPLD measures a delay time when trigger pulse is inputted. Then CPLD sets the delay pulse to 'H' level and measures a pulse width. ARM microcontroller operates the adjustments of delay and pulse width, and transfers the data back to CPLD.

Figure 3. TTL level double pulse generator.

Table 1. Main specification of TTL level double pulse generator.

Trigger input	TTL level, 1 kHz (typ.)
Output 1	Delay time: 500 μs ~ 2 sec Pulse width: 1 μs ~ 200 μs Time resolution: 100 ns
Output 2	Logical OR of Trigger input and Output 1