Fabrication of the micro-PCR chip and thermal cycling system

Yoon Kyoung Lee*, ***, Young Soo Yoon***,
Dal ho Lee**, Young hwa Shin**, Sang Jik Kwon**
and Jong sung Kim*

*Department of Chemical Engineering,
**Department of Electronic Engineering,
Kyungwon University Sungnam, 151-742, Korea
***Thin Film Technology Research Center, Korea
Institute of Science and Technology, Seoul, 130-650,
Korea E-mail: jskim@kyungwon.ac.kr

PCR (Polymerase chain reaction) is important technology in most molecular biology application. But it takes long time of several hours, though it has small volume of several tens micro liters because conventional reaction is performed in plastic tube. Micro-PCR chip can be reduced time because of the high thermal conductivity and the smaller volume. So there is much interest in developing method to amplify nucleic acid by the PCR in micro fabricated devices.

We demonstrated that reaction well made of silicon-based and glass-based micro-PCR chip because of silicon is most widely used as the micro-PCR chip material in a high thermal conductivity.

Table 1 shows specifics of silicon and glass substrate, respectively. Pyrex glass was used of top substrate because of preventing the breaking in order to difference of thermal coefficient after bonding process.

Figure 1 shows images of micro-PCR chip that is fabricated with MEMS process such as mask design, lithography, wet etching, and anodic and thermal bonding. One of holes is the injection of the DNA sample and the other is used to suction of air.

Figure 2 shows the amplification of p53 gene in the thermal cycler system. We observed the reactions to initial cycle of denaturation at 94℃, followed by 30 cycles of template denaturation at 94℃, primer annealing at the appropriate temperature depending on the PCR system, e.g. 57℃, and extension at 72℃. An additional final extension at 72℃ was also included. After completion of the amplification, the samples were stored at 4℃ until further analysis. The thermal cycling system was composed with peltier, TE cooler and IC sensor.

Figure 3 shows chip-loading state. Two peltier devices ware used to improve the thermal efficiency.

Thus amplification of p53 gene was accomplished in 3 ㎕ and 7 ㎕ reaction well that allowed for accurate control of temperature.

Table 1 specific of the substrate

Substrate	Silicon	Glass
Specific	P-type (100) One side polished 4in x 500 ㎛ SiO_2 3000 Å	Schott Borofloat Double side polished 4in x 0.8 mm

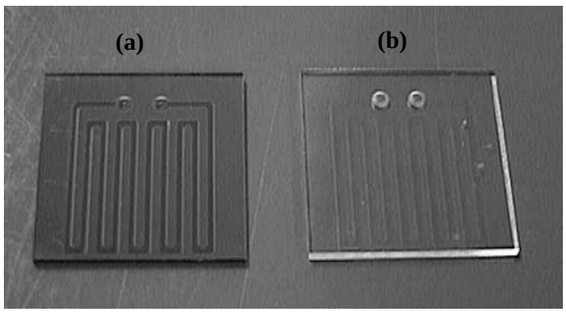

Figure 1. Image of the fabricated micro-PCR chips
(a) Silicon-based micro-PCR chip,
(b) glass-based micro-PCR chip.

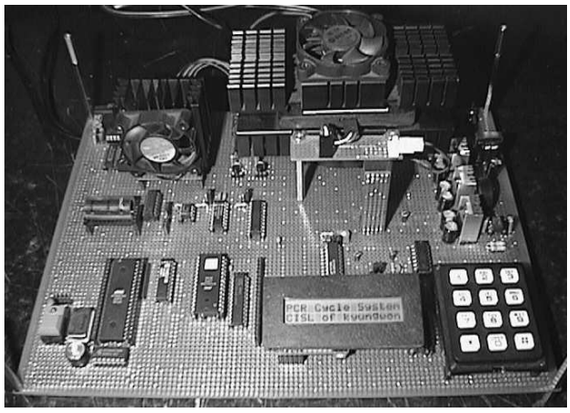

Figure 2. Image of the thermal cycling system

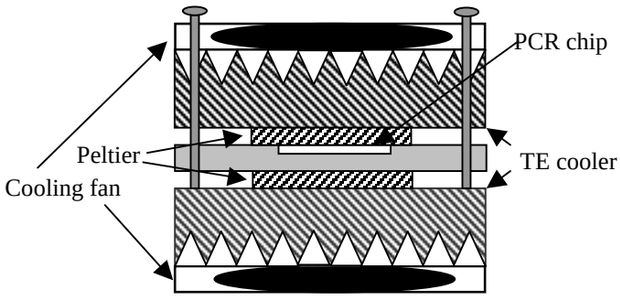

Figure 3. Image of chip loading in the thermal cycling system

ACKNOWLEDGEMENT
This work is financially supported by KRRC.