Abstract 62

DEVELOPMENT OF PORTABLE AND RAPID HUMAN DNA ANALYSIS SYSTEM AIMING ON-SITE SCREENING

Minoru Asogawa[1], Masatoshi Sugisawa[1], Tsutomu Kimura[1], Kan Aoki[1],Hisashi Hagiwara[2], Yoshinori Mishina[2], Tohru Hiramatsu[3] and Toshiyuki Miyamoto[3]
[1]NEC Corporation, 5-7-1 Shiba, Minato-ku, Tokyo,108-8001, Japan
[2]Arbiotec Corporation
[3]Improvise Corporation

Currently we have been developing a multi source human identification system, which can be used for on site screening, aiming for safer world.

To achieve the goal, we have developed a portable and high speed DNA analysis system, which could be utilized on site. For developing such DNA analysis system, we utilized lab on chip method.

Until recently, several portable DNA analysis systems have been proposed, none of them practically in use, however. The reasons follow: the system cost is expensive, the micro-fabricate chip is complicated and expensive, handling the system is intricate, and the analysis time is lengthy.

In this development, we paid much attention not only to high speed process and miniaturizing the mechanism, but also to many aspects peculiar to on site screening, such as, avoiding contamination, easy to use, long preservation time and chip fabrication cost.

The following problems are deliberated and conquered by using breakthrough technologies:
(1) balloon-chip technology which makes possible disposable chip by merely bonding several silicon films,
(2) technology to manipulate micro fluid without using syringe pump,
(3) high speed PCR for micro fluid,
(4) electrophoresis analysis program.

Using prototype system, it is demonstrated that DNA extraction, PCR and mCE is achieved 4 min., 15 min. and 6 min. respectively. Thus the total time is 25 min.

We have developed balloon-chip technology which makes possible disposable chip by merely bonding several silicon films. Before bonding films, patterns of adhesive and non-adhesive area are art worked. After bonding, liquid can get through only non-adhesive area between silicon film. By making holes on each silicon film, micro liter liquid can be manipulated. Advantage of this technology, comparing to commonly used the gutter type chip, fabrication is much easier and less expensive, controlling liquid is much easier, and no air purging is necessary, since the liquid pass is closed before usage.

We have developed high speed micro PCR. Small size Peltier device, under PCR chambers, are utilized for high speed thermal cycling process. The thermal ramp speed is 13.2[C/sec] for increasing and 10.7[C/sec] for decreasing.

In electrophoresis, two size markers are included, accompany with amplicon of miniSTR. Those size markers are used for DNA length measurement compensation. We have developed STR analysis program, based on super resolution technique.

We would like to thank to Dr. Kentaro Kasai, Dr. Kazumasa Sekiguchi, Dr. Natsuko Mizuno, Dr. Hiroaki Senju of the National Research Institute of Police Science, JAPAN, for their valuable and generous discussion.