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New Technology for DNA Chips on a Microarray-Random Fluidic Self-assembly Method Using Hydrophobic Interaction

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New Technology for DNA Chips on a Microarray – Random Fluidic Self-assembly Method Using Hydrophobic Interaction

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In this paper, we describe a new approach for an arrangement of many kinds of DNAs on transducers to construct a DNA microarray. A high-density array of sensor probes was prepared by randomly distributing a mixture of particles immobilized with various DNAs. A process for immobilization of the DNAs was separated from the assembly of the particles. The particles were arranged on the chip pattern by random fluidic self-assembly, using hydrophobic interaction.

Keywords: Random fluidic self-assembly method; Hydrophobic interaction; Particle; DNA chip microarray

INTRODUCTION

One high throughput method by which to gain information about gene function is the gridded DNA microarray[1]-[3]. On realizing the power of this approach, we decided to build high–speed, high–precision arrayers. The robot built by P. Brown[4] at Stanford Medical School first demonstrated the feasibility of this approach. Our goals are (i) to

construct a multifunctional DNA microarray and (ii) to develop a new approach for the immobilization of many kinds of DNAs. A high-density array of sensor probes was prepared by randomly distributing a mixture of particles. The particles were arranged on the chip pattern by the random fluidic self-assembly method using a hydrophobic interaction.

EXPERIMENTAL

One side of cover glass was made hydrophobic by cyclized perfluoro polymer (CPFP) treatment. Cr/Au was evaporated on the other side. The particles with CPFP and Cr/Au were cut from cover glass using a dicing machine, were 100~400μm in length. The primary DNAs (A, B and A+B) were immobilized on the particles through thiol derivatives and avidin as cited[5]. The target cDNAs were modified with FITC. The patterned chip for arrangement of the particles was made by process of photolithography and O_2 plasma. Hydrophobic sites about 2,600~34,000 were fabricated. The particles were arranged by the random fluidic self-assembly method on the patterned chip, using a hydrophobic interaction. The particles were arranged in the suspension of ethanol 90% and distilled water 10%. The immobilization of DNAs and hybridization for cDNA were evaluated by fluorescence.

RESULTS AND DISCUSSION

Figure 1 shows fluorescence changes when hybridized with FITC modified target cDNAs (A`, B` and A+B`) on DNA chip microarray which the particles were arranged onto the chip pattern. In Figure 1 (a),

almost mixed particles were randomly placed onto the hydrophobic sites and there was no fluorescence in the circles because primary DNAs were not hybridized with the target cDNAs. The FITC modified target cDNAs were inserted sequencely. In Figure 1 (b), the fluorescence could be seen within the circles only when hybridized with A`. In Figure 1 (c), however, the fluorescence also could be seen within the circles when B` was hybridized. In Figure 1 (d), the fluorescence also could be seen in the circles by A+B`. These results show the applicability to DNA chip microarrays.

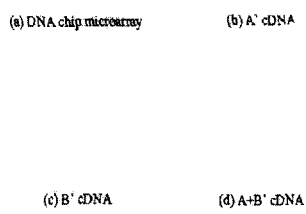

FIGURE 1 Fluorescence changes when hybridized with FITC modified target cDNAs.

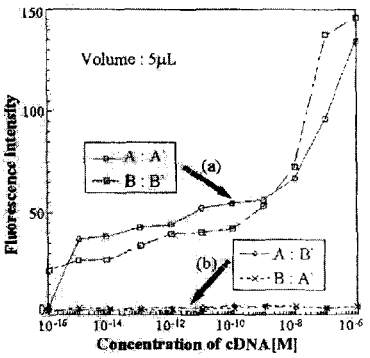

FIGURE 2 The fluorescence intensity dependence on the concentration according to the target cDNA.

Figure 2 shows the fluorescence intensity dependence on the concentration of A and B primary DNA according to the FITC modified target DNA from 0.1fM to 1μM (5μL). In Figure 2 (a), the fluorescence intensity increases with FITC modified target cDNA. An almost linear relationship for the fluorescence intensity dependence on

the concentration over 10^{-15}M can be seen. In Figure 2 (b), however, there was no fluorescence for the non-complementary DNAs completely.

CONCLUSION

Arrangement of the particles for DNA chip microarray, and fluorescence measurements were carried out. Almost mixed particles were randomly placed onto the hydrophobic sites. The fluorescence changes when hybridized with target cDNAs and the fluorescence intensity dependence on the concentration can be seen. Advantages of this method are process simplicity, wide applicability, and stability and can apply to DNA chip microarrays.

References

[1]M. Schena, D. Shalon, R.W. Davis & P.O. Brown, Science **270**, 467–470 (1995).

[2]J. DeRisi *et al.*, Nature Genet., **14**, 457– 460 (1997).

[3]J.L. DeRisi, V.R. Iyer & P.O. Brown, Science **278**, 680–686 (1997).

[4]Refer to http://cmgm.stanford.edu/pbrown/index.html.

[5]Y. S. Choi *et al.*, *The 3rd Asian Symposium on Organized Molecular Films for Electronics and Photonics & The 11th Molecular Electronics and Devices Symposium*, 355-356 (2000).