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We report here a new approach for an arrangement of many kinds of DNAs on transducers to construct a multifunctional DNA chip. The particles were arranged on the chip pattern by the random fluidic self-assembly method, using a hydrophobic interaction for a assembly. The immobilization of DNAs was evaluated by fluorescence.

Keywords: Random fluidic self-assembly method; Hydrophobic interaction; DNA chips array

INTRODUCTION

Immobilization of biomaterials and their stability on the transducer of a sensor are important for a multifunctional DNA chips application. A problem for a multifunctional DNA chip is how to arrange the various biomaterials onto a densely integrated transducer array. Arrays can be categorized according to their transduction mechanisms which include surface acoustic wave sensors[1], solid-state sensors[2], fiber-optic sensors[3], and fluorescence sensors[4]. These arrays are fabricated using conventional techniques such as ink-jet printing[5], screen printing and photolithography[6]. However, until now, no research has been

employed using a hydrophobic interaction for a assembly.

We report here a new approach for the arrangement of many kinds of biomaterials on transducers to construct multifunctional DNA chips. A high-density array of sensor probes were 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 for a assembly. The immobilization of DNAs was evaluated by fluorescence.

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 DNAs were immobilized on the particles as cited[7]. The A, B and A+B biotinylated DNAs were used. These primary DNAs have the following sequence; 5`GA AAAAAAATGACGTCATCCG3`, 5`AGGAATTCCCAAGCTTGGCA3` and 5`GAAAAAAAATGAGTCATCCG–AGGAATTCCCAAGCTTG GCA3`. The complementary target DNAs (cDNAs) [A(21bp), B(20bp), A+B(41bp)] were modified with FITC (fluorescence isothiocyanate).

The chip pattern for arrangement of the particles was made by a process of photolithography and O_2 plasma. The particles were arranged on the chip pattern by the random fluidic self-assembly method, using a hydrophobic interaction for a assembly. The immobilization of the primary DNAs and the hybridization of the target cDNAs to the primary DNAs were evaluated by fluorescence.

RESULTS AND DISCUSSION

Figure 1 shows the concentration dependence of the fluorescence intensity

of A, B and A+B primary DNAs (1μM) according to a FITC modified target cDNAs from 0.1fM to 1μM (5μL). In Figure 1 (a), the fluorescence intensity increases with a target cDNAs modified by FITC. An almost linear relationship for concentration dependence of fluorescence intensity can be seen. The fluorescence intensity depends on the concentration of cDNAs because these were modified with FITC. In Figure 1 (b), however, there was no fluorescence for the non-complementary DNAs completely.

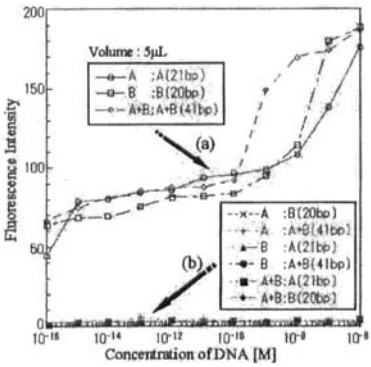

FIGURE 1. The concentration dependence of fluorescence intensity according to (a) a target cDNA and (b) non-complementary DNAs.

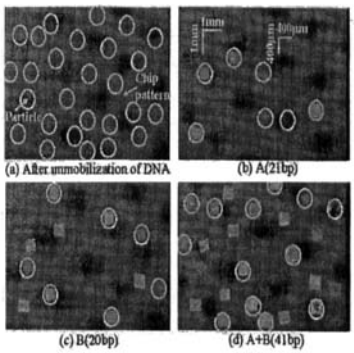

FIGURE 2. Fluorescence changes when hybridized with the FITC modified target cDNAs.

Figure 2 shows fluorescence changes when hybridized with FITC modified target cDNAs on DNA chip microarrays which the particles were arranged onto the chip pattern. In Figure 2 (a), 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 2 (b), the fluorescence could be seen within the circles only when hybridized with A(21bp). In Figure 2 (c), however, the fluorescence also could be seen within the circles when B(20bp)

was hybridized. In Figure 2 (d), the fluorescence also could be seen in the circles by A+B(41bp). These fluorescences were resulted from the hybridization of cDNA into the primary DNA. These results show that the hydrophobic interaction is applicable to fabrication of DNA chips.

CONCLUSION

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

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References

[1] E.T. Zellers, S.A. Batterman, M. Han and S.J. Patrash, *Anal. Chem.*, **67**, 1092 (1995).
[2] A.E. Bruno et al., *Anal. Chem.*, **69**, 507 (1997).
[3] T.A. Dickinson, J. White, J.S. Kauer and D.R. Walt, *Nature*, **382**, 697 (1996).
[4] Y. Murakami et al., *T. IEE Japan*, **119-E**, 436 (1999).
[5] A.V. Lemmo, J.T. Fisher, H.M. Geysen and D.J. Rose, *Anal. Chem.*, **69**, 543 (1997).
[6] S.P.A. Fodor et al., *Science*, **251**, 767 (1991).
[7] Y. Okahata et al., *Biochem.*, **37**, 5666 (1998).