

Gene Microarray의 기본개념

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Basic Concept of Gene Microarray

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ABSTRACT

The genome sequencing project has generated and will continue to generate enormous amounts of sequence data including 5 eukaryotic and about 60 prokaryotic genomes. Given this ever-increasing amounts of sequence information, new strategies are necessary to efficiently pursue the next phase of the genome project - the elucidation of gene expression patterns and gene product function on a whole genome scale. In order to assign functional information to the genome sequence, DNA chip(or gene microarray) technology was developed to efficiently identify the differential expression pattern of independent biological samples. DNA chip provides a new tool for genome expression analysis that may revolutionize many aspects of biotechnology including new drug discovery and disease diagnostics.

KEY WORDS : Genome · DNA chip · Gene microarray · Expression · Bioinformatics.

서론

가 .

(genome)

(RNA)

가 . 1995

functional genomics

Haemophilus influenzae

(structural genomics)

(functional genomics)

5 가 (1).

21

10 Archaea 50

가 100

(<http://www.tigr.org/tdb/mdb/mdb.html>).

가 가

(DNA sequencing)

post genome

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가

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가 DNA

chip(Gene chip)

Table 1. Complete Genomes

Eukaryote	<i>Arabidopsis thaliana</i> , <i>Caenorhabditis elegans</i> , <i>Drosophila melanogaster</i> , <i>Homo sapiens</i> , <i>Saccharomyces cerevisiae</i>
Archaea	<i>Aeropyrum pernix</i> K1, <i>Archaeolobus fulgidus</i> , <i>Halobacterium species</i> NRC-1, <i>Methanobacterium thermoautotrophicum</i> delta H, <i>Methanococcus jannaschii</i> , <i>Pyrococcus abyssi</i> , <i>Pyrococcus horikoshii</i> OT3, <i>Sulfolobus solfataricus</i> , <i>Thermoplasma acidophilum</i> , <i>Thermoplasma volcanium</i>
Prokaryote	<i>Aquifex aeolicus</i> , <i>Bacillus halodurans</i> , <i>Bacillus subtilis</i> , <i>Borrelia burgdorferi</i> , <i>Buchnera</i> sp. APS, <i>Campylobacter jejuni</i> , <i>Caulobacter crescentus</i> , <i>Chlamydia muridarum</i> , <i>Chlamydia trachomatis</i> serovar D(D/UW-3/Cx) & MoPn, <i>Chlamydia pneumoniae</i> AR39, <i>Chlamydia pneumoniae</i> CWL029 & J138, <i>Clostridium acetobutylicum</i> , <i>Deinococcus radiodurans</i> R1, <i>Escherichia coli</i> K-12 & O157 : H7 & O157 : H7 EDL933, <i>Haemophilus influenzae</i> Rd, <i>Helicobacter pylori</i> 26695 & J99, <i>Lactococcus lactis</i> subsp. <i>Lactis</i> , <i>Mesorhizobium loti</i> , <i>Mycobacterium leprae</i> , <i>Mycobacterium tuberculosis</i> CDC 1551 & H37Rv, <i>Mycoplasma genitalium</i> , <i>Mycoplasma pneumoniae</i> , <i>Mycoplasma pulmonis</i> , <i>Neisseria meningitidis</i> MC58 & Z2491, <i>Pasteurella multocida</i> , <i>Pseudomonas aeruginosa</i> , <i>Rickettsia prowazekii</i> , <i>Staphylococcus aureus</i> subsp. <i>Aureus</i> Mu50 & N315, <i>Streptococcus pneumoniae</i> , <i>Streptococcus pyogenes</i> M1 GAS, <i>Synechocystis</i> sp. PCC6803, <i>Thermotoga maritima</i> , <i>Treponema pallidum</i> , <i>Ureaplasma urealyticum</i> , <i>Vibrio cholerae</i> , <i>Xylella fastidiosa</i>

Table 2. DNA chip fabrication techniques

			chip	
Pin microarray	Pin dotting	micro	cDNA & oligonucleotide	Beecher Instruments Biorobotics Cartesian Technologies GenoCheck Genomic Solutions Genetic Microsystems Hyseq Incyte Genomics Molecular dynamics Takara Cartesian Technologies Incyte genomics
Inkjet	Inkjet micro dropping		cDNA & oligonucleotide	Packard Instruments Rosetta
Photolithography	Photolithography	oligonucleotide	oligonucleotide	Affymetrix
Electronic array		oligonucleotide addressing	oligonucleotide	Motolora(CMS) Nanogen

DNA chip

DNA chip 이란?

DNA chip

DNA

DNA chip

DNA

DNA chip

Southern Northern blot,

DNA sequencing

가

DNA chip

cDNA chip oligonucleotide chip

DNA chip

cDNA

chip

500bp

(full - length open leading

frame

EST)가

, oligonucleotide chip

15~25

oligonucleotide가

DNA chip

DNA chip의 종류와 활용도

1. DNA chip 제작 방법에 의한 분류

DNA chip

4가

2

1) Pin microarray chip

Pin microarray chip

1995

Stanford

3~4

1 cm²

(<http://cmgm.stanford.edu/pbrown/>).

cDNA

chip

cDNA microarray chip

oligonucleotide

chip

cDNA

microarray chip

(1, Duggan 1999)

EST PCR

96 - well

384 -

well plate

slide

microarrayer

가 DNA microarrayer

XYZ plotter

pin DNA

plate

glass

slide computer가

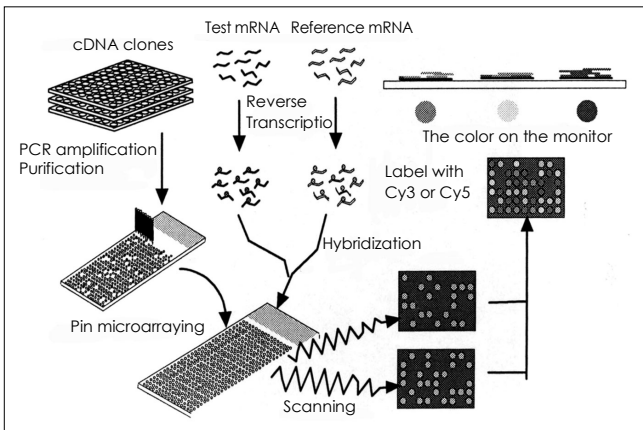


Fig. 1. Schema of cDNA microarray chip.

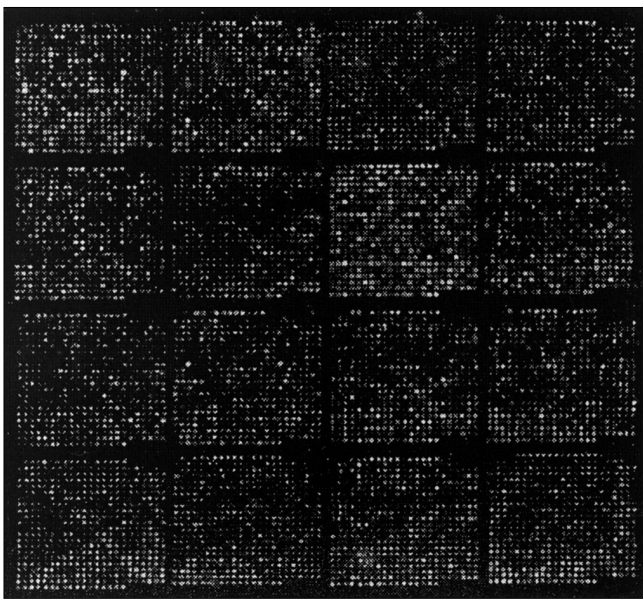


Fig. 2. cDNA microarray chip.

cDNA microarray chip 가

1 mRNA (reverse transcription)

(Cy5) (Cy3) cDNA

cDNA cDNA

microarray chip chip laser fluorescence scanner

2 computer 8,000 가 cDNA microarray chip 가 (()

). 가

CGAP (cancer genome anatomy project) cDNA microarray chip

가

2) Inkjet microarray chip

Inkjet DNA chip

microarray chip pin

computer inkjet printer cartridge

ridge cartridge

가

solenoid piezoelectric 3가 thermal, chip

가 chip

3) Photholithograph chip

silicon valley Affymetrix computer chip photolithography (nucleotide)

(http://www.affymetrix.com/). 20

computer 21 Affymetrix 1.

28cm² 400,000 oligonucleotide 가 chip

oligonucleotide 15~25

Oligonucleotide가 chip

가 (3,

Lipshutz RJ 1999).

photomask 가
 chip 가 가
 가 가
 chip photomask
 400,000 25mer(25
 가 oligonucleotide) 100cycle
 cDNA microarray chip oligonucleotide
 chip chip 가 25mer
 oligonucleotide chip
 가 20 25
 mer
 (annealing temperature)가 가
 25mer
 chip 가
 20 25mer 가

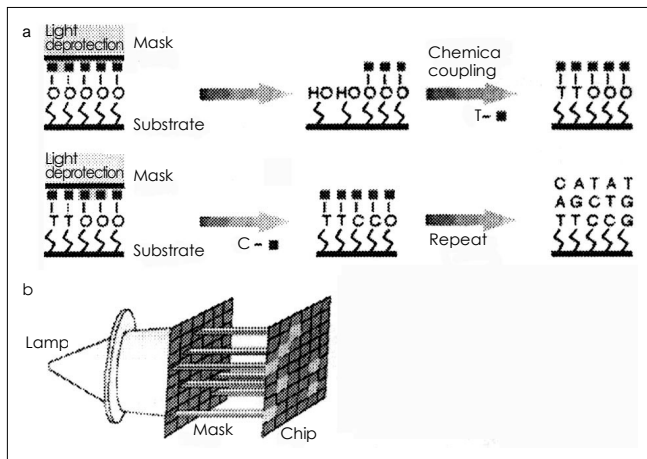


Fig. 3. Affymetrix chip.

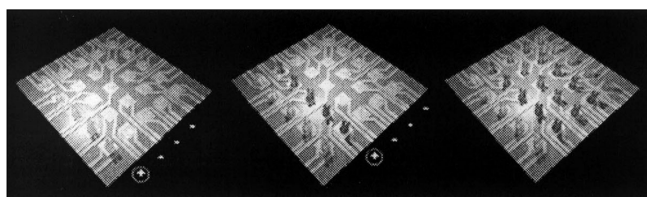


Fig. 4. Electronic addressing.

oligonucleotide chip cDNA
 microarray chip 가

Affymetrix oligonucleotide chip

(point mutation) Affymetrix chip
 p53 BRCA1 가 chip, AIDS
 HIV chip, SNP(single nucleotide
 polymorphism) chip

4) Electronic array DNA chip

DNA가 (-) chip
 (+)
 (4, <http://www.nanogen.com/>).
 chip Nanogen
 (<http://www.nanogen.com/>).
 ctronic addressing ele-
 target DNA

DNA
 가 DNA
 Nanogen chip
 Clinical Micro Sensors
 (<http://www.microsensor.com/>).
 가 laser scanner

2. DNA chip 활용 분야

cDNA chip oligonucleo-
 tide chip

Table 3. Applications of DNA chip

cDNA chip	가	Oligonucleotide chip	가
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DNA
 가
 가
 (, ..)
 DNA

Table 4. Softwares for DNA chip analysis

Software
ArrayMaker, ScanAlyze, Cluster, Xcluster, TreeView, Stanford Microarray DB, GeneChip Analysis Suite, GeneChip LIMS, GeneChip Data Mining Tool, GeneSight, Genesight, Microarray Project, cDNA DB, EPODB, RNA Abundance DB, LifeArray, Expressionist, GeneExpress, ArrayExpress, ExpressDB, Gene Expression Omnibus, Resolver, GeneSpring, Array Explorer, SSBM, GXD, ChipDB, CyberT, EPCLUST, Data Explorer, JMViewer, ArrayScout, SeqArray, GenePixPro, ArrayVision, IPLab MicroArray Suite, GeneX, maxd, AMAD, GenomeXtools, GeneSpring

결론

가 가
 가
 DNA chip 가

가
 oligonucleotide chip
 가 DNA chip
 3 DNA chip
 DNA chip
 가
 3 DNA chip
 DNA chip
 가
 DNA chip
 ID, 가
 DNA chip
 DNA chip 가
 DNA 가
 DNA chip

가
 bioinformatics() 가
 가
 DNA chip bioinformatics
 DNA chip 가
 software data (DNA
 4). laboratory on a chip
 chip
 가
 100 DNA chip
 가
 가
중심 단어 : Genome · DNA chip · Gene microarray · Expression · Bioinformatics.

참고문헌

Duggan DJ, Bittner M, Chen Y, Meltzer P, Trent JM(1999) : *Expression profiling using cDNA microarrays, Nat Genet Supp 21 : 10-14*
 Lipshutz RJ, Fodor SPA, Gingeras TR, Lockhart DJ(1999) : *High density synthetic oligonucleotide arrays, Nat Genet Supp 21 : 20-24*