

Microarray Market in India

- Dr. K. R. Kumaraswamy

What is Microarray?

DNA Microarray technology

High-density DNA arrays make it possible to monitor the expression levels of thousands of genes at a time, and are being used to address old questions in new ways and to generate new hypothesis.

DNA arrays are among the most powerful and versatile tools for Genomics and Genetics Research. Based on the sequence information, it is possible to measure the gene expression of tens of thousands of genes at a time.

Microarray devices work by hybridization of DNA or RNA to DNA sequences that are immobilized at physical locations on a solid support.

There are two dominant types of DNA microarrays as outlined below that are being used for most global gene expression measurement. Each one has its own advantage, however, the trend is towards Oligonucleotide microarrays.

Oligonucleotide Microarrays

These are high-density arrays that are synthesized in-situ on silicon wafer using light-directed combinatorial synthesis, which are referred to as GeneChips. It primarily uses photolithography and semiconductor fabrication technology and contains hundreds of ordered, single-stranded Oligonucleotides that are typically 25 bases in length to accommodate more than 50,000 genes on a single microarray. Each gene is generally represented by multiple number of probes.

Spotted Microarrays

Spotted cDNA microarrays have cDNA spotted at specific locations on a glass slide. The cDNAs, usually PCR products, are 500 to 1000 bases in length, are spaced about 100 to 300 microns apart, allowing for upto 20,000 spots to be placed on a standard microscopic glass slide. Usually there is one spot for each gene. The information that is obtained from these

Market Dynamics in India

- ⇒ Indian microarray business for 2007 is estimated to be around \$ 5 Million and is expected to grow to \$ 12 Million by the year 2010.
- ⇒ There are over 75 microarray scanners and systems installed in the country so far. 80% of the microarray users are from the research and development segment.
- ⇒ Many customers have graduated themselves from cDNA to oligo-based technology.
- ⇒ Microarray aftermarket comprising of arrays and reagent kits is the fastest growing microarray market segment.
- ⇒ Microarray molecular diagnostic solutions are in the offing thereby improving healthcare and heralding the era of personalized medicine.

microarrays generally gives the relative concentration (ratio) of a given transcript when two conditions are compared.

Advantages

Oligonucleotide arrays have several specific advantages. For example, they can be designed and made directly from sequence information.

Large number of probes are used to increase detection redundancy (i.e.

there are many probes per gene). Moreover, shorter probes will reduce cross-hybridization and increase specificity and the ability to discriminate between closely related members of gene families.

Applications

Recent advances in microarray help unravel biological complexities. Microarrays virtually have multifarious applications – Analysis of Gene Expression, Genotyping and Resequencing in Human, Eukaryotes, Prokaryotes and Plant genomes.

Better microarray instrumentation, higher throughput and lower cost continue to draw more users from a variety of scientific disciplines to use this technology for understanding the molecular signatures in various diseases including cancer, infectious diseases, stem cells, human

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variations, etc. The expanding use of DNA microarrays has provided impetus to understand clinical diagnostics, bio-defense, forensics and agriculture. DNA microarrays have found increasing applications in drug discovery, including lead optimization, toxicity studies, screening and monitoring of patient data during clinical trials.

Microarray technology, used in the 1990s to explore the human genome, is today the powerful research tool for human diagnostics. More and more companies are coming out with diagnostic devices based on microarray technology.

The Global Market for Microarray

Since the inception in mid 1990s, the use of microarrays has spread rapidly throughout the research community. The recent technological advancements in microarray analysis have revolutionized understanding fundamental aspects of the growth and development as well as the molecular mechanisms underlying causes of many human diseases. Microarray technology helps in understanding the structure-function relationship, thereby heralding the era of *New Biology*. Researchers who carry out microarray experiments ask big questions and the results generate large quantities of data. Bioinformatics power therefore needs to step up to the challenges that have been created by microarray technology.

The global market for microarrays with an estimated revenue of \$ 1 Billion currently is anticipated to grow to a projected revenue of \$ 1.5 Billion by the year 2010. Affymetrix microarray is considered to be the Gold Standard and is the market leader with over 2000 platforms. Microarray technology is dominated by aftermarket sales comprising of arrays and reagents. Aftermarket is the fastest growing microarray market segment. 45% of the microarray users are from academia.

As prices have dropped, users have been relying on commercial arrays, rather than homebrew products. 80% of the microarray users are from the research and development. The majority of the R & D projects take place within pharmaceutical and biotechnology industries, followed by academia and government labs. North America is the largest consumer of microarray and accounts for 45% of the global microarray business.

Indian Market

It was in early 2000 when Indian Institute of Science, Bangalore established the first spotted microarray facility in India. Since then the microarray systems market in India has witnessed some level of growth but the major technological advancements which came up in the last couple of years has given the real push. There are many suppliers of different microarray technologies – Oligo based photolithography(Affymetrix), oligo based inkjet(Agilent), Bead based(Illumina), MalDI based (Sequenom), etc. The traditional cDNA based microarray systems are also available from Molecular Devices Corporation(Axon), Perkin Elmer and Genomic Solutions.

Approximately there are over 75 microarray scanners and systems installed in the country so far. Even relatively late

entrants into the Indian market such as Affymetrix have been able to quickly build up over a dozen GeneChip platforms within 3 years. Indian microarray business for 2007 is estimated to be around \$ 5 Million and is expected to grow to \$ 12 Million by the year 2010.

The impetus is provided by the Department of Biotechnology which is the nodal funding agency for biotech research in India. Centers of Genomic Excellence are being set up for effective utilization of such technologies to Indian needs. Many scientists are using microarrays for their analysis of gene expression and genotyping. Microarray systems are being utilized in various research institutes, universities, medical research labs, agricultural research labs, pharma industries and service providers. Many customers have graduated themselves from cDNA to oligo-based technology. Most of the cDNA slides are imported and some are spotted within the country. Consortia for Human SNP, Rice genome, etc exist in the country. Many large projects are being undertaken for various life style diseases, both for the analysis of gene expression and genotyping. Many publications have appeared in international journals. Many research communities are interested in custom arrays for agriculture and healthcare.

Future Trend

Microarray technology has become an indispensable tool to understand the structure-function relationship so that the quality of life of human beings, animals and plants can improve. At the same time, it helps to understand nature's mysteries to unravel the complexity of biological questions. Microarray technology is expected to move from the labs to genetic clinics. IVD will be the major focus for microarray technology. Microarray will be used for routine screening of microorganisms. Concurrent microarray technology to accommodate multiple organisms in single analysis is another major focus. High throughput microarray is being used for drug discovery, Pharmacogenomics and SNP analysis. Better instrumentation, higher throughput, and lower cost continue to draw more users from a variety of scientific disciplines.

The importance of DNA microarrays in research for disease diagnosis, understanding drug interactions, and determining drug candidates is expected to fuel further growth in this market.

Furthermore, the power of microarray technologies is being explored in the arena of diagnostics for taking therapeutic decisions. Gene expression analysis provides vital information at the molecular level. Regulatory agencies such as the US FDA have also scrutinized various microarray technologies and vendors for use in commercial diagnostics – Affymetrix was the only USFDA approved microarray manufacturer so far. Utilizing this opportunity, companies such as Roche have successfully brought out microarray based diagnostic chips for commercial use. Many more microarray molecular diagnostic solutions are in the offing thereby improving healthcare and heralding the era of personalized medicine. ■