An Overview of the Manufacturing of GenChip® Microarrays

GeneChip® Microarrays Curriculum
(in support of Activity #3)
GeneChip® System

Probe Arrays (chips)

Fluidics Station

Software Data Analysis

Scanner
Substrate Preparation

Synthesis
- Chemistry
- Photolithography

Packaging
Synthesis of Ordered Oligonucleotide Arrays

The diagram illustrates the process of synthesizing ordered oligonucleotide arrays. It shows the steps involved in attaching nucleotides to a wafer, with light (deprotection) used to expose specific areas for further attachment. The process is repeated for a 25-mer oligonucleotide, resulting in the formation of a GeneChip® Microarray.
The GeneChip® Substrate

49 Chips per Wafer

400 Chips per Wafer
Substrate Cleaning & Coating
Substrate Cleaning & Coating
Substrate Silanation

Wafer

Polyimide Coating
Chemical Synthesis Station
Photolithographic Synthesis

- Lamp
- Mask
- Chip
- Feature
A Typical Mask
Spatial Photo-Activation

UV Light

Photo Mask

Wafer

Feature #1

Feature #2

Feature #3

Feature #4
Base Addition – Adenine

Wafer

Feature #1     Feature #2     Feature #3     Feature #4
Spatial Photo-Activation

UV Light

Photo Mask

Photo Mask

Wafer

Feature #1  Feature #2  Feature #3  Feature #4
Base Addition – Guanine

[Diagram showing base addition with Guanine and various nucleotides like G-p, C-p, A-p, and L]
# Spatial Photo-Activation

**UV Light**

**Photo Mask**

**Wafer**

<table>
<thead>
<tr>
<th>Feature #1</th>
<th>Feature #2</th>
<th>Feature #3</th>
<th>Feature #4</th>
</tr>
</thead>
</table>

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**UV Light**

**Photo Mask**

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Base Addition – Thymine

Thymine

Wafer

Feature #1 | Feature #2 | Feature #3 | Feature #4
Capping of Incomplete Additions

Capping Agent

Wafer

Feature #1  Feature #2  Feature #3  Feature #4
Completed Synthesis Product

The Way Ahead™

Wafer

Feature #1  Feature #2  Feature #3  Feature #4
Chip Packaging
Pick and Place Station
### A Scalable Manufacturing Process

<table>
<thead>
<tr>
<th>Feature Size</th>
<th>Features*</th>
<th>Resequencing$^{1}$</th>
<th>Expression$^{2}$ Monitoring</th>
<th>Genotyping$^{3}$</th>
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</thead>
<tbody>
<tr>
<td>100µm</td>
<td>16,000</td>
<td>2kb</td>
<td>400 - 2,000</td>
<td>800 markers</td>
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<tr>
<td>50µm</td>
<td>64,000</td>
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<td>1,600 - 8,000</td>
<td>3,200 markers</td>
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<td>20µm</td>
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<td>50kb</td>
<td>10,000 - 50,000</td>
<td>20,000 markers</td>
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<tr>
<td>10µm</td>
<td>1.6 million</td>
<td>200kb</td>
<td>40,000 - 200,000</td>
<td>80,000 markers</td>
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</tbody>
</table>

* (1.28cm)$^{2}$ chip

1 8 probes/base

2 8 - 40 probes/gene

3 20 probes/marker
Mask Designs Represent Array Content

Expression analysis

Genotyping analysis

DNA sequence analysis