Microfluidic Platform for High-Density Multiplexed Biological Assays

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We have developed a microfluidics-based technology that will support the ongoing need to reduce the cost and increase the capabilities of genetic testing in areas such as: population studies for the identification of inherited disease genes, more effective evaluation of drug candidates, and rapid determination of gene expression in tissues for disease management. This technology will also reduce the cost of the clinical testing of novel genetic targets related to disease risk and drug response.

Specific improvements promised by this technology are the following:

- Provides a flexible microfluidic enabling platform for genomic, proteomic and cellular array-based assays;
- Can be used with current diagnostic protocols and instrumentation;
- Tests many samples in parallel on the same microarray;
- Reduces the time it takes to perform genetic tests on microarrays from hours to minutes.

The elastomeric microfluidic device can print high-density DNA microarrays with dimensions as small as 10 µm. The device (Figure 1), which hermetically seals to a glass slide, patterns hundreds of DNA targets in parallel as lines on the glass surface. DNA samples are introduced into the sample entry ports and drawn along the channels, where they are exposed to and bind to the slide. After patterning, subsequent probe-target hybridization is simply achieved by running fluorescently labeled samples orthogonally over the target DNA-patterned glass slide, using a second microfluidic chip. Hybridization is achieved in less than 5 minutes; orders of magnitude faster than conventional DNA microarrays that require 16 hours for the same process. Using 10 µm wide microchannels, the hybridization spot density can be increased to over 400,000 assays per cm².

Figure 1: Illustration of DNA target printing and subsequent probe hybridization using a microfluidic array device.