Biochips and BioMEMS for Analytics and Medical Diagnostics

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The dream of analytics for daily life is an analytical device, that takes up the sample, does any necessary follow up step and finally presents the data; the user does not see any of the complex preparation and measuring steps inside the device. Such a device is very desirable, e.g. in point of care situations. This notion is condensed in what has been called “lab on a chip” or “micro total analysis system (μTAS)”. Both have the aim to integrate sample pre-treatment like cleaning, separation and amplification as well as signal generation and transduction in a self content manner.

Up to now some of the mentioned steps have already been integrated. The most advanced lab-on-chip devices in connection with nucleic acids are examples of miniaturised electrophoresis. The capillary electrophoresis use capillaries of 50 μm inner diameter that easily can be condensed by winding channels without loss of separation capability.

The second area, where BioMEMS will add much value to analysis is the polymerase chain reaction (PCR), that enables biologists to get much amount of material from a minimum of sample. Here many approaches have been reported, that perform PCR in whole silicon-devices or micro-fabricated single chip machines.

Third, high parallelisation of analytical procedures helps to get more information from a single sample. Microarray technology allows massive parallel determination of binding events and it has the advantages of requiring a small amount of material and a modest investment of labor. Microarrays in general consist of many microscopic spots each containing identical molecules. The numbers of spots may vary from less than 100 to several 100.000. In the case of nucleic acids, the receptors are usually oligonucleotides or cDNA, and the binding event is simply the hybridisation of complementary strands. Combination of microarray technology with microfluidics will help to create high effective and valuable analytical devices.