Microchip Electrophoresis

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Microchip electrophoresis (MCE) is a miniaturized form of capillary electrophoresis. Electrophoresis is a common technique to separate macromolecules such as nucleic acids (DNA, RNA) and proteins. This technique has become a routine method for DNA size fragmenting and separating protein mixtures in most laboratories around the world. The application of higher voltages in MCE achieves faster and efficient electrophoretic separations.

Keywords: electrophoresis ; microchip electrophoresis ; microfluidics ; microfabrications

Electrophoresis is an analytical technique that has been applied to resolve complex mixtures containing DNA, proteins, and other chemical or biological species. Since its discovery in the 1930s by Arne [1], traditional slab gel electrophoresis (SGE) has been widely used until today. Meanwhile, new separation techniques based on electrophoresis continue to be developed in the 21st century, especially in life sciences. Capillary electrophoresis (CE) provides a higher resolution of the separated analytes and allows the automation of the operation. Thus, it has been widely used to characterize proteins and peptides [2], biopharmaceutical drugs [3], nucleic acids [4], and the genome [5]. The development of microfabrication techniques has led to the further miniaturization of electrophoresis known as microchip electrophoresis (MCE). MCE offers many advantages over conventional capillary electrophoresis techniques such as the integration of different separation functions onto the chip, the consumption of small amounts of sample and reagents, faster analyses and efficient separations [6][7]. As a few additional functions such as sample preparation, washing, and incubation with antibodies and derivatization with dyes can be integrated on a single stamp size microchip, MCE has the potential to be adapted for portable POC and clinical diagnostics devices. Microchip electrophoresis provides separations within a minute or few seconds while capillary electrophoresis takes from minutes to hours to fully resolve the components of the sample mixture. MCE also offers the integration of detection methods such as electrochemical detections, laser induced fluorescence detections and interface with mass spectrometry. As a result, MCE has been used in a variety of applications, e.g., to analyze biomolecules in blood [8], saliva [9], tear [10], dialysate [11], and islets [12].

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