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Editorial Open Access

Capillary Electrophoresis (CE)

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Abstract

Capillary electrophoresis (CE) is a family of electrokinetic separation methods performed in submillimeter diameter capillaries and in micro- and nanofluidic channels. Very often, CE refers to capillary zone electrophoresis (CZE), but other electrophoretic techniques including capillary gel electrophoresis (CGE), capillary isoelectric focusing (CIEF), capillary isotachophoresis and micellar electrokinetic chromatography (MEKC) belong also to this class of methods.1 In CE methods, analytes migrate through electrolyte solutions under the influence of an electric field. Analytes can be separated according to ionic mobility and/or partitioning into an alternate phase via non-covalent interactions. Additionally, analytes may be concentrated or "focused" by means of gradients in conductivity and pH.

Editorial

Pollution Endeavors in capillary electrophoresis (CE) began as early as the late 1800's. Experiments began with the use of glass U tubes and trials of both gel and free solutions.2 In 1930, Arnes Tiselius first showed the capability of electrophoresis in an experiment that showed the separation of proteins in free solutions.3 His work had gone unnoticed until Hjerten introduced the use of capillaries in the 1960's. However, their establishments were not widely recognized until Jorgenson and Lukacs published papers showing the ability of capillary electrophoresis to perform separations that seemed unachievable. Employing a capillary in electrophoresis had solved some common problems in traditional electrophoresis. For example, the thin dimensions of the capillaries greatly increased the surface to volume ratio, which eliminated overheating by high voltages. The increased efficiency and the amazing separating capabilities of capillary electrophoresis spurred a growing interest among the scientific society to execute further developments in the technique.

One of the main applications of CE in forensic science is the development of methods for amplification and detection of DNA fragments using polymerase chain reaction (PCR), which has led to rapid and dramatic advances in forensic DNA analysis. DNA separations are carried out using thin CE 50-mm fused silica capillaries filled with a sieving buffer. These capillaries have excellent capabilities to dissipate heat, permitting much higher electric field strengths to be used than slab gel electrophoresis. Therefore separations in capillaries are rapid and efficient. Additionally, the capillaries can be easily refilled and changed for efficient and automated injections. Detection occurs via fluorescence through a window etched in the capillary. Both single-capillary and capillary-array instruments are available with array systems capable of running 16 or more samples simultaneously for increased throughput.4

Another application of CE in forensics is ink analysis, where the analysis of inkjet printing inks is becoming more necessary due to increasingly frequent counterfeiting of documents printed by inkjet printers. The chemical composition of inks provides very important information in cases of fraudulent documents and counterfeit banknotes. Micellar electrophoretic capillary chromatography (MECC) has been developed and applied to the analysis of inks extracted from paper. Due to its high resolving power relative to inks containing several chemically similar substances, differences between inks from the same manufacturer can also be distinguished. This makes it suitable for evaluating the origin of documents based on the chemical composition of inks. It is worth noting that because of the possible compatibility of the same cartridge with different printer models, the differentiation of inks on the basis of their MECC electrophoretic profiles is a more reliable method for the determination of the ink cartridge of origin (its producer and cartridge number) rather than the printer model of origin.

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