

Publication

A portable lab-on-a-chip instrument based on MCE with dual topbottom capacitive coupled contactless conductivity detector in replaceable cell cartridge

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A new design for a compact portable lab-on-a-chip instrument based on MCE and dual capacitively coupled contactless conductivity detection (dC4D) is described. The instrument is battery powered with total dimension of 14 x 25 x 8 cm³ (w x l x h), and weighs 1.2 kg. The device consists of a front electrophoresis compartment which has the chip holder and the chip, the associated high-voltage electrodes for electrophoresis injection and separation and the detector. The detection cell is integrated into the device housing with an exchangeable plug-and-play cartridge format. The design of the dC4D cell has been optimized for maximum performance. The cartridge includes the topbottom excitation and pick up electrodes incorporated into the cell and connected to push-pull self-latching pins that are insulated with plastic. The metal frame of the cartridge is grounded completely to eliminate electronic interferences. The cartridge is designed to clamp a thin fluidic chip at the detection point. The cartridges are replaceable whereby different cartridges have different detection electrode configurations to employ according to the sensitivity or resolution needed in the specific analytical application. The second compartment consists of all the electronics, data acquisition card, high-voltage modules of up to +/- 5kV both polarity, and batteries for 10 h of operation. The improved detector performance is illustrated by the electrophoresis analysis of six cations (NH₄⁺, K⁺, Ca²⁺, Na⁺, Mg²⁺, Li⁺) with a detection limit of approximately 5 M and the analysis of the anions (Br, Cl, NO₂, NO₃, SO₄²⁻, F) with a detection limit of about 3 M. Analytical capabilities of the instrument for food and medical applications were evaluated by simultaneous detection of organic and inorganic acids in fruit juice and inorganic cations and anions in rabbit blood samples and human urine samples are also demonstrated.

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