PALMTOP FULLY-INTEGRATED CAPILLARY ELECTROPHORESIS ANALYZER
J.Z. Pan, P. Fang, X.X. Fang, Q. Li, Y.Q. Chen and Q. Fang*
Institute of Microanalytical Systems, Department of Chemistry, Zhejiang University, 310058, Hangzhou, CHINA

ABSTRACT
This paper reports a palmtop miniaturized capillary electrophoresis analyzer with a size of 7 cm×5 cm×7 cm, which integrates all of the modules for fast capillary electrophoresis (CE) system, including a short capillary, high-voltage power supply (2000 V), automated picoliter-scale sample injection device, laser-induced fluorescence (LIF) detector, and electronic control system. Three sample introduction modes were provided in the CE system to analysis different type of analytes. The LIF detector adopted an orthogonal optical arrangement with a violet 405 nm laser diode as excitation source and a photodiode as photodetector. A limit of detection of 1.9×10^-7 mol/L for fluorescein was obtained. The analyzer was applied in the fast separation of amino acids and DNA fragments.

KEYWORDS: Palmtop, Capillary electrophoresis analyzer, Laser-induced fluorescence detector

INTRODUCTION
Fast CE systems obtain both high speed and high efficiency separations by the use of short separation lengths and high separation field. Various fast CE systems have been developed using the microfluidic chip technique. However these systems present limitations such as complex fabrication process of microchips, complicated structure of instrument and requirement of skilled labor. In this work, a short-capillary-based fast CE analyzer was developed to provide a simple and fast way for electrophoresis separation.

EXPERIMENTAL
The analyzer was composed of CE system, LIF detector and electronic control system. The CE system consisted of a short fused-silica capillary, programmed high voltage power supply and an automated sample introduction system with slotted sample and buffer reservoirs and a translational stage. Three sample introduction modes, including spontaneous injection[1], electrokinetic injection and partial spontaneous injection[2], were realized by combining the programmed high voltage power supply and automated sample introduction system. The LIF detector adopted a orthogonal optical arrangement[3] and employed a violet 405 nm laser diode as excitation source. A small size photodiode was chosen to as the photo-detector. An electronic control system based on a microcontroller MSP430F1611 was developed to automatically achieve the CE operation including sample injection, electrophoresis, detection and data processing. The electropherogram can be displayed on a LCD display in real time and restored in the trans-flash(TF) card. The analyzer is powered by a rechargeable Li-ion battery and the size of the analyzer is only 7 cm×5 cm×7 cm.
RESULTS AND DISCUSSION

The limit of detection of the LIF detector was $1.9 \times 10^{-7}$ mol/L for fluorescein. The analytical performance of the analyzer was evaluated in the separation of amino acids and DNA fragments. Under the spontaneous injection sampling mode, the separation of a mixture of three amino acids was achieved within 130 s with an effective separation length of 25 mm. The theoretical plates per meter are ranged from 29,000 to 101,000. The separation of 150 bp DNA ladder marker was achieved within 480 s with electrokinetic injection mode.
Figure 4. Electropherogram of a mixture of 50 μM FITC-labeled amino acids.

Figure 5. Electropherogram of 150 bp DNA Ladder Marker

CONCLUSION
In this work, all modules for CE separation were fully integrated into the small-sized analyzer. Benefitting from the small size and rapid analysis, the palmtop CE analyzer was expected to be applied in point of care testing or analysis, such as in-situ immunoassay.

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REFERENCES

CONTACT
* Q. fang; phone: +86-571-8820-6771; Fangqun@zju.edu.cn