## B74 On-Site Forensic Analyses Using Capillary Electrophoresis On-A-Chip

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After attending this presentation, attendees will learn about current efforts to develop field-portable cost-effective, quantitative, and defensible analytical methods for screening a wide array of substances/materials at crime scenes

This presentation will impact the forensic community and/or humanity by informing the forensic science community of the current research to develop a rapid, cost-effective, quantitative, and defensible analytical method for screening a wide array of substances/materials at crime scenes. Deployment of the CE-Chip can aid in on-site determination of the evidentiary value of a substance thus reducing, or eliminating, the collection and submission of unnecessary samples. The device can also be used within local police facilities for preliminary and follow-up analysis thus reducing the amount of evidence to be submitted to a crime lab facility.

The presentation describes research towards the development of a portable capillary electrophoresis (CE-Chip) system that employs electroanalytic, laser-induced fluorescence and absorbance detection for the analysis of a wide-range of analytes of forensic interest. Over the past few years, there has been a sustained effort to develop reliable portable systems for the field-based detection of drugs, explosive materials, and other agents. Capillary electrophoresis is a mature technology with many advantages over ion-mobility spectroscopy and gas and liquid chromatography methods including greater efficiency, analysis times on the order of seconds to just a few minutes, and sample volumes on the order of pico- to nanoliters.

A central goal of the research is to develop a rapid, cost-effective, quantitative, and defensible analytical method for screening a wide array of substances/materials at crime scenes. Deployment of the CE-Chip can aid in on-site determination of the evidentiary value of a substance thus reducing, or eliminating, the collection, and submission of unnecessary samples. The device can also be used within local police facilities for preliminary and follow-up analysis thus reducing the amount of evidence to be submitted to a crime lab facility. Capillary electrophoresis can provide the same information as gas chromatography-mass spectroscopy, Fourier-transform spectroscopy, and scanning electron microscopy-energy dispersive X-Ray analytical methods for a fraction of the cost – in time and money – or can aid in the determination of evidence to be submitted for confirmatory tests using the above techniques.

The prototype system uses glass chips with outer dimensions of 45x15x1.8 mm. The width and depth of the channels between reservoirs are 50 µm and 20 µm, respectively, with the buffer, sample, and waste reservoirs 2.4 mm in diameter. Separation length is 35 mm. The glass chips were purchased from Micronit Technologies, UK but several vendors, such as Microlyne, USA, manufacture comparable substrates. The prototype employs UV-VIS detection. One of the two surface- mounted light-emitting diodes (LEDs) is mounted directly above the separation channel; whereas, the other is used as a reference. Prior to sample injection, the lamp intensities are adjusted and balanced by use of a comparator. Once the separating potential is applied, the output of the comparator is monitored – as analyte elutes past the detector window, the output deviates from the null balance. Using this configuration, signal-to- noise is a function of slit width (S/N increases with decreasing slit width). Currently, we are using 100- µm diameter slits.

Sample injection and the electrophoretic separation are achieved using two separate, but identical, power supplies. The power supplies are capable of supplying between 275 to 2000 volts. Currently, the prototype uses an AC adapter with a built-in 9-volt transformer but the design can be easily reconfigured for use with two 9-V batteries thus making the unit field-portable. Initial experiments use bromocresol green as the target analyte because the conjugate base has a large molar absorptivity coefficient in the yellow-region of the visible spectrum, which facilitates troubleshooting design modifications. Prior to sample loading, the channels were rinsed with 0.1M NaOH for 60 seconds. The running buffer was a 10 mM sodium borate solution adjusted to pH 7.5 using 0.1 M HCl. A two-step high-voltage procedure was employed to inject the sample and perform the separation. Sample injection was achieved by applying 600 V to the waste reservoir while grounding the sample, buffer, and detector reservoirs. Once sample injection was complete, a separation voltage of 1000 V was applied to the detector reservoir and the buffer reservoir was grounded. At the same time a 300 V potential was applied to both the sample and waste reservoirs to avoid leakage of analyte from the sample and waste channels into the separation channel. Based on the above operating conditions, the migration time for bromocresol green is 64.5 seconds.

The cost to manufacture a device that employs both electroanalytic and LIF detection methods is estimated at $750.00 U.S.

**Analytical Chemistry, Capillary Electrophoresis, Criminalistics**

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