**Electrochemical Detection for Microchip Separation Devices**

Charles S. Henry, Yan Liu, Joseph C. Fanguy, Yali Jia
*Department of Chemistry*
*Mississippi State University*
*118 Hand Laboratory Mississippi State, MS 39762*

The investigation and development of microchip separation systems, including capillary electrophoresis, electrochromatography, and liquid chromatography, has gathered significant attention.[1,2] The interest in microchip separations is due to the ability to perform rapid separations (<1-2 min) while maintaining high separation efficiency and resolution. Microchip separation systems have been used successfully for the separation of DNA, proteins, and small molecule species.

Detection in microchip separation devices has focused primarily on the use of laser-induced fluorescence (LIF). LIF is attractive because it is very sensitive and relatively easy to integrate with the microchip systems. LIF, however, requires lasers and photodetectors that are large and expensive in comparison to the microchips. Furthermore, most analyte molecules do not possess native fluorescence at useful wavelengths and therefore require derivatization for detection. Derivatization adds complexity and cost to the overall analysis scheme. For these reasons, several groups have developed alternative detection schemes with mass spectrometry and electrochemistry being the most common.

Electrochemical detection in microchip separation devices appears to be an ideal marriage.[3] Electrochemical detectors, microelectrodes, are small and, unlike optical methods, do not lose signal linearly with decreasing size. Furthermore, the control instrumentation, potentiostats, can be miniaturized to the same size scale as the microchip. Finally, many analytes can be detected naturally without the need for derivatization simplifying the analysis process. The development of electrochemical detection for microchip separations will be presented here. Amperometric, pulsed amperometric (PAD), and conductivity detection have been used in our laboratory for detection with microchip capillary electrophoresis.

The use of electrochemical detection for detection of uric acid in urine will be discussed. An off-column electrochemical detector has been constructed. Off-column detection utilizes an electrode that is separate from the microchip and aligned using a three-axis positioner. This system allows for the use of a wide variety of electrode materials while providing good reproducibility and sensitivity. Initial characterization of the system has shown the limit of detection for easily oxidized compounds (i.e. dopamine and uric acid) to be 1 micromolar. Using the off-column system, we have shown the detection of uric acid from urine samples (Figure 1). Results obtained with the microchip system (674.3 mg uric acid/24 hrs) compared favorably with a conventional clinical analysis kit (695.8 mg uric acid/24 hr). A comparison of electrode characteristics and their effect on detection performance will be shown. In addition, the use of pulsed waveforms for detection of other clinically relevant analytes will be shown.

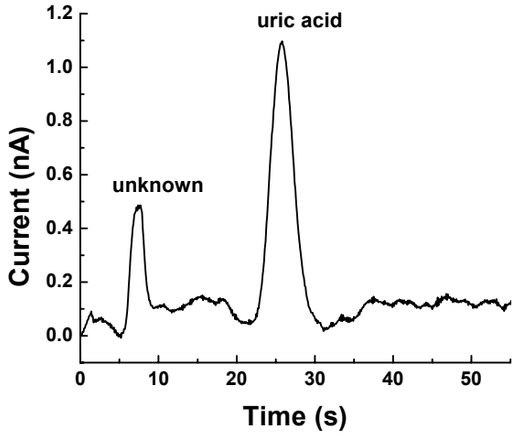


**Figure 1.** Detection of Uric Acid in Urine Using Amperometric Detection with the Off-Chip Configuration

1)Dolnik, V.; Liu, S.; Jovanovich, S. *Electrophoresis* **2000**, *21*, 41-54.
2)Soper, S. A.; Ford, S. M.; Qi, S.; McCarley, R. L.; Kelly, K.; Murphy, M. C. *Anal. Chem.* **2000**, *72*, 642A-651A.
3)Lacher, N. A.; Garrison, K. E.; Martin, R. S.; Lunte, S. M. *Electrophoresis* **2001**, *22*, 2526-2536.