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Separation Science and Technology

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Selected Publications

Three-dimensional Stochastic Simulation for the Unified Treatment of Chromatographic and Electrophoretic Separations, V.L. McGuffin, P.E. Krouskop, and D.L. Hopkins, *Unified Chromatography, ACS Symposium Series 748*, 37 (2000).

Fluorescence Quenching as an Indirect Detection Method for Nitrated Explosives, J.V. Goodpaster and V.L. McGuffin, *Anal. Chem.* **2001**, *73*, 2004.

Characterization of Polycyclic Aromatic Hydrocarbons in Environmental Samples by Selective Fluorescence Quenching, S.B. Howerton, J.V. Goodpaster, and V.L. McGuffin, *Anal. Chim. Acta* **2002**, *459*, 61.

Stochastic Simulation of the Partition Mechanism with a Heterogeneous Surface Phase, P.E. Krouskop and V.L. McGuffin, *J. Chromatogr. A* **2002**, *959*, 49.

Thermodynamics and Kinetics of Solute Transfer in Reversed-phase Liquid Chromatography, V.L. McGuffin and C. Lee, *J. Chromatogr. A* **2003**, *987*, 3.

Although high-efficiency capillary columns have been used routinely in gas chromatography for many years, only recently have they become available for condensed mobile phases. Our research group is interested in the development of novel packed and open tubular capillary columns for liquid and supercritical fluid chromatography as well as electrophoresis. These capillary columns are capable of achieving very high separation efficiencies (10^5–10^6 theoretical plates) and concurrently reducing the consumption of both sample and solvent. Our initial studies of new column technology involve the characterization of hydrodynamic performance and comparison with theoretical models. In later investigations, the chemical performance of the column is established through detailed analysis of solute-solvent and solute-sorbent interactions. The goal of these fundamental studies is to improve our physical and chemical understanding of separation processes in order to develop columns that more nearly approach the theoretical limits of performance.

Because of the small dimensions and low flow rates characteristic of capillary columns, very sensitive, low-volume detectors are required. Conventional detection techniques such as refractive index, UV absorbance, fluorescence, and electrochemical measurements cannot adequately detect trace analytes that are present at the nano- to femtogram level in complex samples. Consequently, we are interested in the development of other detection techniques that better fulfill the rigorous requirements of capillary columns. Currently, we are pursuing the development of laser-based detectors for both fluorescence and photoionization measurements because of their high sensitivity and selectivity.

Our final research goal involves the application of the improved separation and detection techniques developed in our laboratory to problems of environmental, forensic, and biochemical significance. Laser-induced fluorescence detection has been applied to the analysis of naturally fluorescent molecules such as polynuclear aromatic hydrocarbons present in coal and fuel oil samples. In addition, many molecules that are not inherently fluorescent may be chemically modified to incorporate a fluorescent label. Such labels have been successfully employed for the detection of amino acids, bile acids, fatty acids, prostaglandins, and steroids. The high separation efficiency of capillary chromatography and electrophoresis, when coupled with highly sensitive and selective laser-based detection techniques, provides a powerful analytical system for complex clinical and environmental samples.