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Current Research

The majority of our research is centered on the design, formulation, and optimization of several types of surfactant aggregates (micelles, microemulsions, vesicles, and liposomes) that can be used as separation media in voltage- or pressure-driven chromatographic techniques, i.e., electrokinetic chromatography (EKC) and micellar liquid chromatography (MLC). EKC and MLC can be used to separate a diverse range of hydrophobic and hydrophilic compounds including charged and neutral drug enantiomers; they can also be employed to measure or predict physicochemical parameters such as octanol-water partition coefficients ($\log P_{ow}$), acid-base dissociation constants (pK_a), and drug membrane permeability ($\log P_{perm}$). If employed in a parallel 96-capillary instrument, EKC has the potential be a useful, complementary technique for the high-throughput screening of pharmaceutical drug candidates. For MLC, the direct introduction of biological samples with no sample pretreatment (except filtration) is one of its greatest strengths.

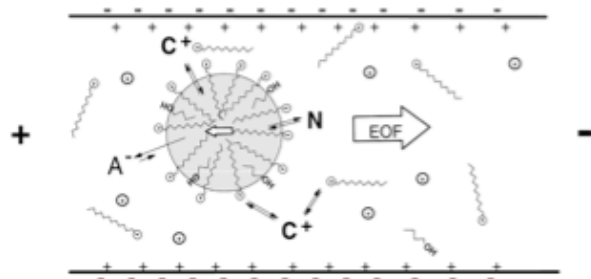


Figure 1. Schematic representation of electrokinetic chromatography with a microemulsion pseudostationary phase and cationic (C^+), neutral (N) and anionic (A^-) analytes.

We are also interested in various fundamental aspects of separation science, including the unification of separate theories for four liquid-phase separation techniques: high performance liquid chromatography (HPLC), capillary zone electrophoresis (CZE), electrokinetic chromatography (EKC), and capillary electrochromatography (CEC). Our approach is to derive and then experimentally verify a master resolution (R_s) equation that (i) will be applicable to all of the above techniques; and (ii) will reduce to previously-reported, separate expressions for these techniques when their respective constraints are invoked. In addition, the master R_s equation will be able to correctly describe the resolution classes and of

analytes under conditions in which previous EKC and CEC theory is inapplicable.

Our pioneering use of chiral microemulsions in EKC allows—besides a complementary method for separating enantiomers—a careful study of the synergies of stereoselective interactions between chiral surfactant, co-surfactant, and/or oil. Despite the seeming complexity of utilizing chiral microemulsions as pseudostationary phases (PSPs) in EKC (eight combinations of R- or S-surfactant, R- or S-cosurfactant, and R- or S-oil), control experiments are easily executed via the use of racemic mixtures. Currently we are beginning careful experiments designed to correct for the presence potential impurities, chiral or otherwise, in one or more of our chiral microemulsion components.



Recent Publications

B. S. Weekley and J. P. Foley, Dual Opposite Injection Capillary Zone Electrophoresis: Theoretical Aspects and Application to Organic and Pharmaceutical Compounds. *Electrophoresis*, **2007**, 28, 697-711.

D. P. Thomas and J. P. Foley. Efficiency Enhancements in Micellar Liquid Chromatography Through Selection of Stationary Phase and Alcohol Modifier. *J. Chromatogr. A*, **2007**, 1149, 282-293.

E. Jantratid, S. Prakongpan, J. P. Foley, and J. B. Dressman. Convenient and Rapid Determination of Cimetidine in Human Plasma using Perchloric Acid-Mediated Plasma Protein Precipitation and High-Performance Liquid Chromatography. *Biomed. Chromatogr.*, **2007**, 21, 949-957.

K. A. Kahle and J. P. Foley. Review of Aqueous Chiral Electrokinetic Chromatography with an Emphasis on Chiral Microemulsion EKC. *Electrophoresis*, **2007**, 28, 2503-2526.