# NISTTech

**Versatile, Simple Microfluidics for Field Portable Applications**

**Microfluidic analysis system combining multiple process steps into one simple operation for robust, reliable, and high quality results in the field**

## Description

This process is a combination of inventions, and it provides a simple application for the analysis of chemical or biochemical samples. It enables chemical measurements to be made at the point of use, such as at a doctor's office, or in a food or chemical manufacturing plant. Rather than using complex, multiple step processes for analysis of samples, this process results in one simple operation that allows complex samples to be analyzed with little or no sample pretreatment.

The simplicity means there are fewer things that can go wrong, which is critically important for realizing a practical field-portable analysis system. In addition, because the system uses electric fields to separate the individual components of a sample, it provides very high quality, reproducible data. This means lower rates of false positives and false negatives, and less time and money wasted on unnecessary responses.

See continuation-in-part #1 and #2 (CIP1 and CIP2) patents below under Citations below.

## Applications

- **Medical Facilities**
  Samples tested and read immediately in the office
- **Food and chemical manufacturing**
  Samples can be analyzed on site for immediate adjustments to manufacturing processes

## Advantages

- **Portable**
  Simple microfluidics for "point-of-use" analysis
- **Reliable**
  Streamlined analysis process leaves a smaller chance of incorrect results

## Abstract

Fluidic Temperature Gradient Focusing: Docket # 01-029

The present invention concerns a method and device for concentrating and separating ionic species in solution within fluid conduits which include channels, microchannels and capillary tubes. The concentration is achieved by balancing the electrophoretic velocity of an analyte against the bulk flow of solution in the presence of a temperature gradient. Unlike previous methods, such as salt bridges or electrodes, which severely limit the type of analyte that can be concentrated, this invention can be adapted for use with any charged analyte, including fluorescent dyes, amino acids, proteins, DNA, cells and particles. Additionally, the use of a temperature gradient prevents the need for an electric field gradient which tends to be difficult to construct and require a control of voltage on an additional electrode. Finally, this invention can be used to achieve higher degrees of sample concentration, which can provide up to or, in some instances, exceed a 10,000-fold concentration of a dilute analyte.

Mixing Reactions by Temperature Gradient Focusing: Docket # 01-029CIP1

A method is provided for observing mixing interactions and reactions of two materials in a fluid. The method in one form provides for concentrating by balancing electrophoretic velocities of a material against the bulk flow of fluid in the presence of a temperature gradient. Using an appropriate fluid, the temperature gradient can generate a corresponding gradient in the electrophoretic velocity of the material so that the electrophoretic and bulk velocities sum to zero at a unique position and the material will be focused at that position. A second material can then be introduced into the fluid and allowed to move through and interact with the focused band of the first material. Products of the interaction can then be detected as they are focused at a different position along the gradient. The method can be adapted to study the temperature dependence of the molecular interaction.

Chiral Temperature Gradient Focusing: Docket # 01-029CIP2

The present invention combines the high resolution of chiral capillary electrophoresis with the high concentration enhancement and low detection limits of temperature gradient focusing. The temperature gradient focusing allows for higher degrees of sample concentration, such as more than a 10,000 fold concentration of a dilute material, when compared with any prior single sample preconcentration method. Additionally, the electrophoretic velocity gradient is formed in response to the temperature gradient without the need for externally manipulated voltages or complicated and difficult to fabricate semi-permeable structures. Finally, the present invention is able to separate stereoisomers of a material which have different affinities for the additive. Essentially, with the addition of a chiral additive, the present focusing method allows for simultaneous separation and concentration of materials that cannot be separated using temperature gradient focusing based purely upon their electrophoretic mobilities. One benefit of being able to separate chiral stereoisomers is that many drugs and drug candidates are chiral and in most cases, one stereoisomer is more desired for drug use than the other. In some instances, one stereoisomer is a beneficial drug, whereas the other results in adverse side effects.

## Inventors

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## Citations


1. NIST Docket # 01-029CIP1, U.S. Patent # 7,537,680
2. NIST Docket # 01-029CIP2, U.S. Patent # 7,572,357
3. K.M. Balss, W.N. Vreeland, K.W. Phinney, and D. Ross. Simultaneous concentration and separation of enantiomers with chiral temperature gradient focusing. Anal. Chem, 76, 7243-7249. 2004.
4. J.G. Shackman, M.S. Munson and D. Ross. Temperature gradient focusing for microchannel separations. Anal Bioanal Chem, 387,155–158, 2007. DOI 10.1007/s00216-006-0913-4
5. H. Lin, J.G. Shackmanb and D. Ross. Finite sample effect in temperature gradient focusing. Lab Chip, 8, 969–978, 2008.
6. J.G. Shackman, M.S. Munson and D. Ross. Gradient elution moving boundary electrophoresis for high-throughput multiplexed microfluidic devices. Anal. Chem, 79, 565-571. 2007.
7. J.G. Shackman and D.Ross. Gradient elution isotachophoresis for enrichment and separation of biomolecules. Anal. Chem, 79, 6641-6649, 2007.


## Related Items

- Article: New Miniaturized Device for Lab-on-a-Chip Separations
- Article: Building Plastic Biochip Devices
- Article: Low-Cost Microfluidics Can Be a Sticky Problem
- MERWYN Business Simulation Report

## References

- U.S. Patent # 7,029,561 issued 04-18-2006 , expires 11/13/2023
- Docket: 01-029US

## Status of Availability

active patent and available for licensing

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