

Microfabricated Field Flow Fractionation Systems

Bruce K Gale, Himanshu J Sant, Avinsh Saldanha, Meregu Srinivas, Mahesh Thoppil
Institute for micromanufacturing, Department of Biomedical Engineering,
Louisiana Tech University.

Introduction:

This work involves the development and testing of several field flow fractionation (FFF) systems including: electrical, cyclical, thermal electric, and electrical SPLIT systems. The μ -FFF system applies thermal or electrical field in the direction perpendicular to the flow of sample to induce the separation as shown in Figure 1. These device finds application in preliminary separations prior to a sensing or analysis step in stand-alone or μ -TAS based biological assays and protein adsorption studies. Fast separations with high selectivity can be obtained through miniaturization and use of higher field strengths in some FFF subtypes. Miniaturization of FFF systems has been shown to significantly improve the function of these devices.

Modeling:

Scaling models for these systems were prepared to study the effect of miniaturization on performance of the device and even compare this device with other micro- and macro-scale FFF systems. The modeling results show improvement in resolution (performance measurement criteria) for all systems with miniaturization.

Fabrication:

The fabrication of the μ -FFF systems is carried out in the clean room area of the Institute for Micromanufacturing (IfM). A polished 4'' <100> silicon wafer having 2 μm SiO_2 is subjected to boron diffusion using SiO_2 as a mask. This step is followed by ICP etching to define the input and output ports. Titanium and gold electrodes are deposited using sputtering system. SU-8 serves as the channel walls for the system. Integration with various microfluidic components and data collection system is performed complete the experimental setup.

Results:

The initial characterization of the system is done using standardized polystyrene samples. Experiments were carried out to measure the improvement in the performance characteristics such as resolution and analysis time with encouraging results. Separation times have been reduced by nearly 10 fold and a number of new systems have been demonstrated.

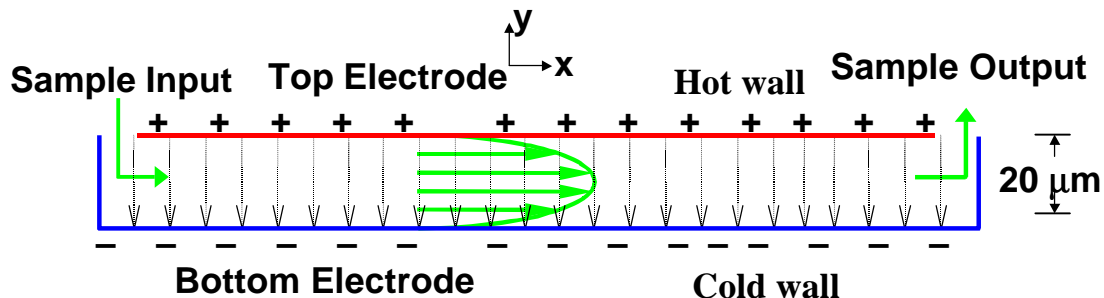


Figure 1 Diagram of operation of TEFFF system showing input and output ports, application of electric field, thermal field, parabolic flow profile, and relative channel dimensions.