Velocity and Temperature Measurement in Microdevices

Prashanta Dutta‡ and Keisuke Horiuchi
School of Mechanical and Materials Engineering
Washington State University, Pullman, WA 99164-2920, USA

Microfluidics is one of the most rapidly growing fields in the microsystem technology due to its breakthrough applications in medical science, biology, and bio-chemistry. Microflow conduits are the fundamental components of any microfluidic device. In last decade, capillaries had been widely used as microflow conduit in different bioanalytical and separation processes due to the high separation efficiencies and peak resolution. Recent developments in microfabrication technologies enabled fabrication of various micro/nanofluidic channel networks for those applications with much more flexibility. In this study, we report velocity and temperature measurement in microchannel networks. Microchannel network is made on poly-di-methyl-siloxane (PDMS) using softlithography and multilayer bonding techniques. The channel height is varied between 3 and 10 microns and the channel width is ranged from 50 to 300 microns.

Micro particle image velocimetry (microPIV) technique is used to obtain the spatial flow velocity distribution in the microchannel. In microPIV technique, volume illumination method is used for obtaining two-dimensional velocity measurements in microchannels since the alignment of light sheet is extremely difficult in microflow geometry. Both electroosmotic and pressure driven flows are measured using microPIV technique. In pressure driven flow a syringe pump is used to drive the flow, while an external electric field is used for electroosmotic flow. Temperature distribution in the microchannel is obtained from an analytical model. For electroosmotic flow, the temperature distribution in the microchannel is primarily due to the internal heat generation as Joule heat. On the other hand, a surface mounted thin foil heater is used to generate thermal energy in the microchannel for pressure driven flows.

‡ Corresponding author and speaker: Tel: 509-335-7989; Fax: 509-335-4662; Email:dutta@mail.wsu.edu