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Characterisation of Pressure Driven Flow in Surface Micromachined Fluidic Devices

ABSTRACT - Masterthesis

One aim of this project is to realise surface micromachined microfluidic channel using electroplating technology. The photoresist (Clariant AZ 4562) is used as a sacrificial layer. The nickel (Enthone MICROFAB NI 100 Sulfamate nickel) is used as an electroplating mould. The use of surface micromachining offers several advantages including reduction in processing time and hence processing cost. In this project, problems arising in the use of a photoresist sacrificial layer are discussed. The new sacrificial layer processes of using electroplating technology and the photoresist as a sacrificial layer for channel fabrication are developed.

Fluid flow in channels and fluidic systems are analysed using the Navier-Stokes equations. As the channel dimensions enter the microscale, the influence of different phenomena's like viscous dissipation and electrokinetic's effects and the friction factor increase. Hence the uncertainty in the measurement is influenced by various parameters. As the measurements are done in microscale the effect of uncertainty plays a major role in the end result. A common method to characterise the flow behaviour of a fluidic system is the gravimetric measurement method. The amount of liquid flowing through the device in a certain period of time is measured using an analytical balance, for determining the flow rate.

With the use of improved gravimetric methods to measure low flow rate, the uncertainties are reduced. The uncertainty in the measurement is dominated by the uncertainty in mass and time measurements. However, several disturbances occurring at gravimetric measurements make this task a challenge at low flow rates. But with the available high resolution, high precision micro balances that are available today, the uncertainties can be made very low.

The main disturbances occurring with the gravimetric measurements are investigated. And a robust measurement setup is built to reduce the measurement uncertainty. Special arrangements have been made concerning evaporation of the liquid, as very small flow rates are measured during a long period of time. Different approaches on this problem are discussed and presented in this thesis. The flow rate and pressure drop measurements were performed and the pressure drop due to microchannel was investigated.