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Investigation of the flow field within a plane micromixer by means of μPIV

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ABSTRACT

The mixing of two liquids in microchannels is a problem which occurs frequently both in miniaturized chemical reactors and in micro analysis devices. Since small channel diameters typically cause small Reynolds numbers, inertia as a means of mixing (as used in makrochannels) is not sufficient. Instead, the flow in microchannels remains dominated by viscous effects and additional measures have to ensure sufficient mixing. Here, multilamination or active external forcing of the flow are alternatives. Multilamination typically requires complicated three-dimensional channel geometries, which do not allow for cheap (mass) production. External forcing, in contrast, may be achieved in simple plane channels by means of pressure forces or electrical forces at the expense of power input.

To understand and to optimize the flow and transport phenomena in a plane micromixer, we engage on one hand theoretical models, which have to allow for an adequate (numerical) simulation of the flow and transport processes in presence of electrical forces within the electrical double layers at the walls. On the other hand, we urgently need reliable experimental data taken in micromixers both on the spatially resolved flow field and on the spatially resolved concentration field. Only these experimental data are able to validate the theoretical models. The measurement of the flow and concentration fields within channels of some 10 μm diameter, in itself, turns out to be a formidable task.

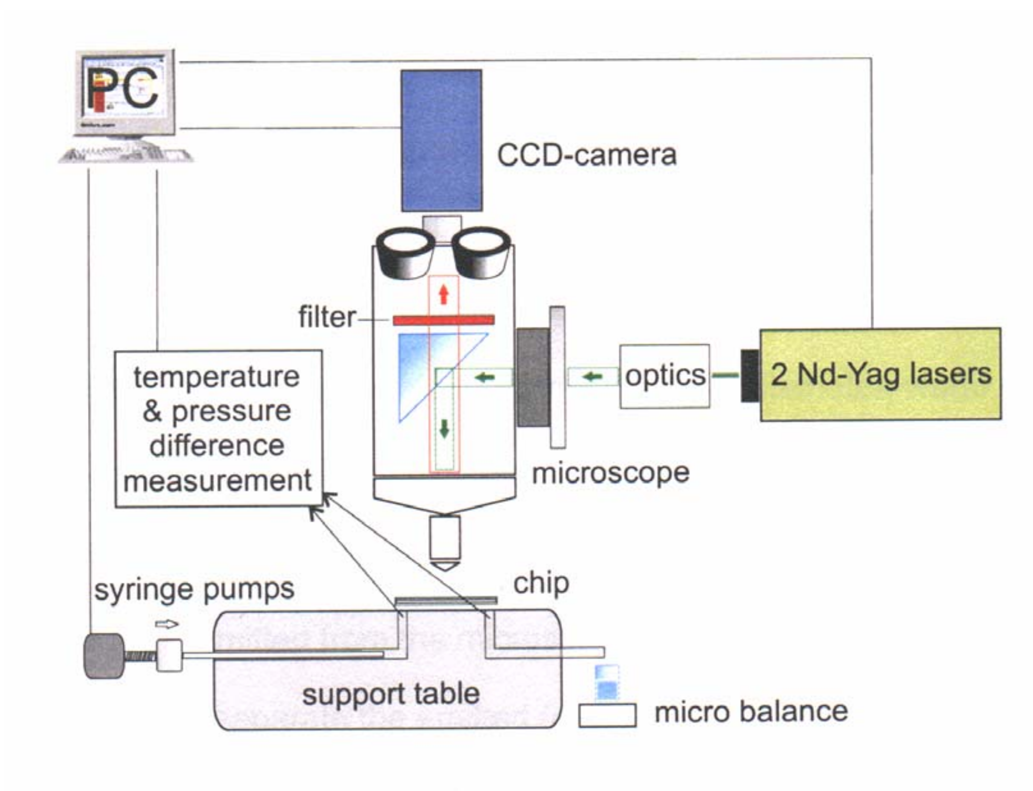

Figure 1: Setup of the microfluid laboratory with measuring technique.