PHYSICAL MATHEMATICS SEMINAR

FAST AND TUNABLE INTEGRATED AC ELECTROKINETIC PUMPING IN A MICROFLUIDIC LOOP

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Increasing complexity in microfluidic devices creates the need for integrated local fluid control systems such as pumps and valves in micro-channels. AC electro-osmosis has been recently advertised as a way of creating fluid rolls over micro-electrodes using low amplitude AC signals [1]. Ajdari [2] proposed a few years ago, based on physical and symmetry principles, that AC electro-osmosis could be used to realize integrated micro-pumps with no moving parts for microfluidic devices. They rely on embedded asymmetric sets of microelectrodes within the channels to generate rectified flows. Experimental reports have since confirmed the validity of the concept, including a contribution from our group [3, 4]. We report here the outcome of a new experiment devised to assess more clearly the performance of such a pump in a microfluidic context, in a clean and reproducible manner. In collaboration with A. Ajdari* we developed an automated microfluidic chip using multilayer soft lithography (Fig. 1). This chip includes an array of microelectrodes for AC-electro-kinetic pumping in a loop channel. We demonstrated the ability of the pump to move liquid in a closed microfluidic loop. A typical velocity is derived from particle image velocimetry. We screened the dependence of the pumping velocity with the amplitude and frequency of the driving signal and the ionic strength of the buffer. We were able to increase the pumping speed up to 500 µm/s in 20 µm deep and 100 µm wide channels with a driving signal in the kHz range with amplitude below 8 Volts. We demonstrate that this type of integrated pumping system is a reliable solution to move fluids in a closed loop.

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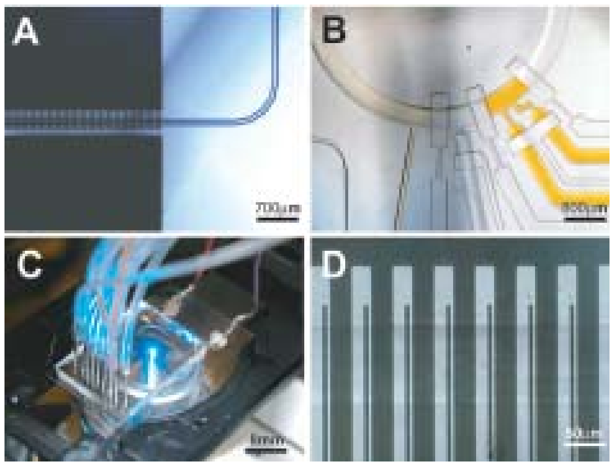

Fig. 1: A : Picture of a section of the pumping loop over the electrode array. B : Detail of the automated chip. C : Picture of the microfluidic chip with fluidic and pneumatic connections, placed over the microscope lens. D : Picture of a section of the electrode array.

TUESDAY, APRIL 6, 2004
2:30 PM
Building 2, Room 338

Refreshments at 3:30 PM in Room 2-349.

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