Electronic Supplementary Material (ESI) for Lab on a Chip.

Lab on a chip supplementary information

Title: Multifunctional microfluidic chips for the single particle inductively coupled plasma mass spectrometry analysis of inorganic nanoparticles

Authors: Gyula Kajner, Albert Kéri, Ádám Bélteki, Sándor Valkai, András Dér, Zsolt Geretovszky, Gábor Galbács

For the inspection and visualization of the flow conditions inside the microfluidic chips, microscope-based imaging experiments using a fluorescent dye (fluorescein) were performed. on an Optika Ti600-FL type microscope (Optika, Italy) equipped with a Kiralux monochrome CMOS scientific camera (Thorlabs Inc., USA). These revealed that the mixing is less satisfactory than shown by the simulations, especially in the case of the TV (Tesla valve) pattern. For all mixers, except the serpentine, bubbles, blockages were often observed (**Fig. S1.)**, as usual in soft polymer microfluidic chips. For these reasons, the serpentine design was chosen to be utilized in the analytical chips.

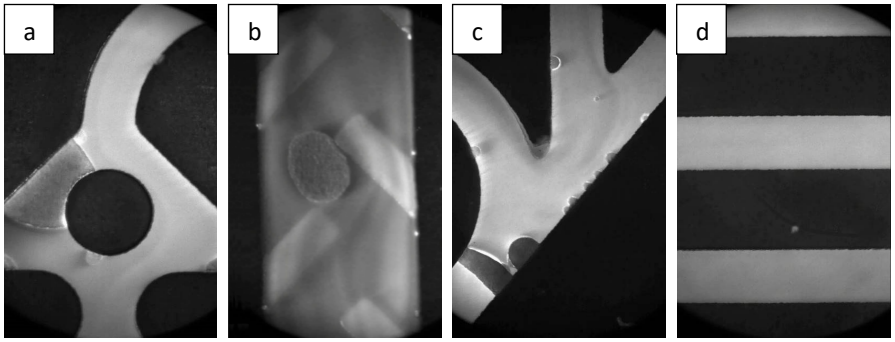

Figure S1. Flow conditions as observed under an optical microscope using a fluorescent dye and inside the *a.)* micropillar, *b.)* fishbone, *c.)* Tesla valve and *d.)* serpentine mixers.

Four additional variants of the serpentine mixer were also created, by varying the width (length of the straight channel sections between the turns) and the length (number of turns) of the units. Narrower designs (e.g. variants 2 and 4) were meant to be particularly space-efficient, as two of these units can be placed on one microscope slide. As data in **Table S1.** show, it was found that the number of turns has a greater effect on the pressure drop (flow resistance) than the length of the channel. As expected, the internal volume

proportionally scaled with the channel length and the number of turns. The simulation results also indicated however that the decrease of the pressure drop, and internal volume can only be achieved at the cost of the repeatability and mixing accuracy.

Derived data	Original SP	SP variant 1	SP variant 2	SP variant 3	SP variant 4
Number of turns	21	22	22	11	11
Channel length between turns [mm]	15.6	7.8	6.0	7.8	6.0
Total internal volume [µL]	101.6	72.8	63.1	43.3	38.5
Pressure drop [Pa]	2319	1461	1229	214.6	167.3
Repeatability of mixing (RSD%)	1.37%	9.24%	8.17%	27.5%	24.6%
Relative deviation from the set dilution rate (RSD%)	0.42%	1.14%	1.35%	6.98%	14.6%

Table S1. Summary of the geometrical and hydrodynamic data of the five tested serpentine mixer designs. Mixing repeatability was calculated based on three repeated experiments.