SUPPLEMENTARY INFORMATION

Finite Element Modeling of the Acoustic Device

The three dimensional model has been implemented in COMSOL Multiphysics (v. 3.4) and includes both the fluid and the adjacent solid structure, comprising the piezoelectric transducer. As demonstrated previously the response to excitation of such an acoustic system can be realistically predicted only by taking into consideration the whole geometry (Neild *et al.,* 2007) and not by considering the fluid volume only. Due to computational power reasons, the model has however been reduced to the central region, extending 1 mm further than the inlet and orifice, respectively.

To simulate the effect of the solid vibration on the fluid, coupling has been defined by equating the velocities of the solid normal to its surface to that of the fluid at the wall, i.e. for a time harmonic excitation this corresponds to equating the acceleration at the wall in the normal direction n_s to the acceleration of the fluid a_n, i.e. $a_n=-\omega^2 u.n_s$, where ω is the frequency of the acoustic wave in the solid, u the solid displacement vector, and n_s the normal vector outbound to the solid wall. The coupling of the fluid response on the solid has been implemented as a mechanical stress balance at the wall; the fluid pressure p acting on the wall has been equated to the normal stress in the solid, $\sigma_{ns} = -p.\ n_s$. The modeled system extends to the middle of the interfaces. At the inlet and orifice zero pressure fluctuation has been set (so called pressure release boundary), which is a realistic assumption considering the large disparity in acoustic impedances. At the other boundaries (channel cross section) zero pressure gradient has been assumed, given the fact that only the central region far from the channel ends is of interest here. As electrical boundary condition, an AC signal has been applied to a small area on the piezoelectric transducer, corresponding to the strip electrode, all other electrodes have been grounded.. Moreover free displacement has been assumed at all free edges and no displacement in the x-direction has been assumed at two *y-z* cross sections. The piezoelectric material parameters correspond to those provided by the manufacturer. Damping has been included in the model by the use of complex stiffness parameters for the solid parts, and a complex speed of sound for the fluid.

In the model gravitational forces, drag forces, interparticle forces (due for instance to the field caused by the wave scattered from a neighbor crystal) and acoustic streaming have been neglected. Gravitation will cause the crystals to lie on the bottom channel surface, but has no further effect. As mentioned previously, as streaming forces scale with the cross sectional area of the crystal, for the sizes of interest, the motion of those crystals is dominated mainly by the acoustic radiation force. Furthermore, the steady-state condition is of interest here; hence drag forces do not play a role. Finally, large crystals are present in such low concentrations that they do not affect each other.

Concerning the implementation of the force equation (Eq. 1), it has to be mentioned that Gor'kov assumes a spherical particle which is far from the walls, in order to neglect the effect of the wave scattered from the particle itself. However, it is fair to assume that the vicinity to a wall would have only an effect on the pressure amplitude rather than a major change in the pressure distribution. Moreover, the shape irregularity would influence the exact motion of the crystal during positioning without having a significant effect on the locations of the trapping site. Even though the results reported here have been calculated for spherical copolymer particles with a diameter of 100 μm ($c_S = 3000$ m/s, $\rho_S = 1050$ kg/m^3, the same type of particles used in Neild *et al.*, 2006) only minor deviations in the force amplitude are expected for crystals (see for instance Edwards *et al.*, 1990).