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

Supplementary Information

Microfluidic-based high-throughput optical trapping of nanoparticles

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1. Position of objective lenses and the microfluidic chip in the optical trapping experimental set-up

Figure S1 shows the positions of the objective and condenser lenses used for optical trapping and collection of the back-focal plane interferometry signal from the trapped particle respectively, separated by a distance of 540 µm ($f_{objective} + f_{condenser} = 540\ \mu m$). The microfluidic chip was carefully fabricated with overall thickness of approximately 400 µm, which could be easily placed between the two objective lenses with the focus of the objective lenses inside the microfluidic channel.

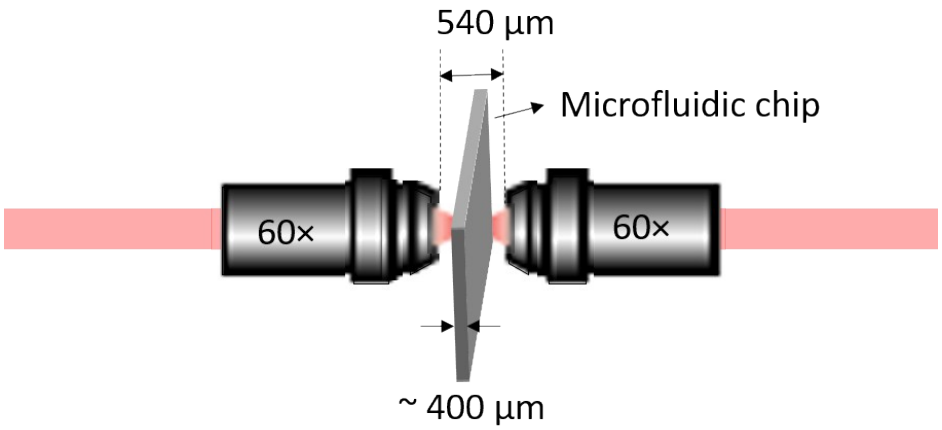

Figure S1 Schematic of a section of the experimental set-up showing the position of the objective and the condenser lenses with respect to the microfluidic chip positioned in between the two lenses.

2. Measurement of concentration of 410-nm fluorescent polystyrene particles

The concentration of the 410-nm polystyrene particle suspension used in the trapping experiments was measured by direct counting of particles under a fluorescence microscope. This was done by flowing the particle suspension in a similar microfluidic chamber which was used for optical trapping except the input and output section were of width 300 µm. Once the chamber was filled with the suspension, the flow was stopped. Thereafter, the particles were observed under the microscope using a mercury lamp for excitation of fluorescent polystyrene particles. Multiple picture frames were collected from the 300-µm section of the channel, at different positions along the length of the channel. Representative images taken from different parts along the channel are shown in Figure S1.

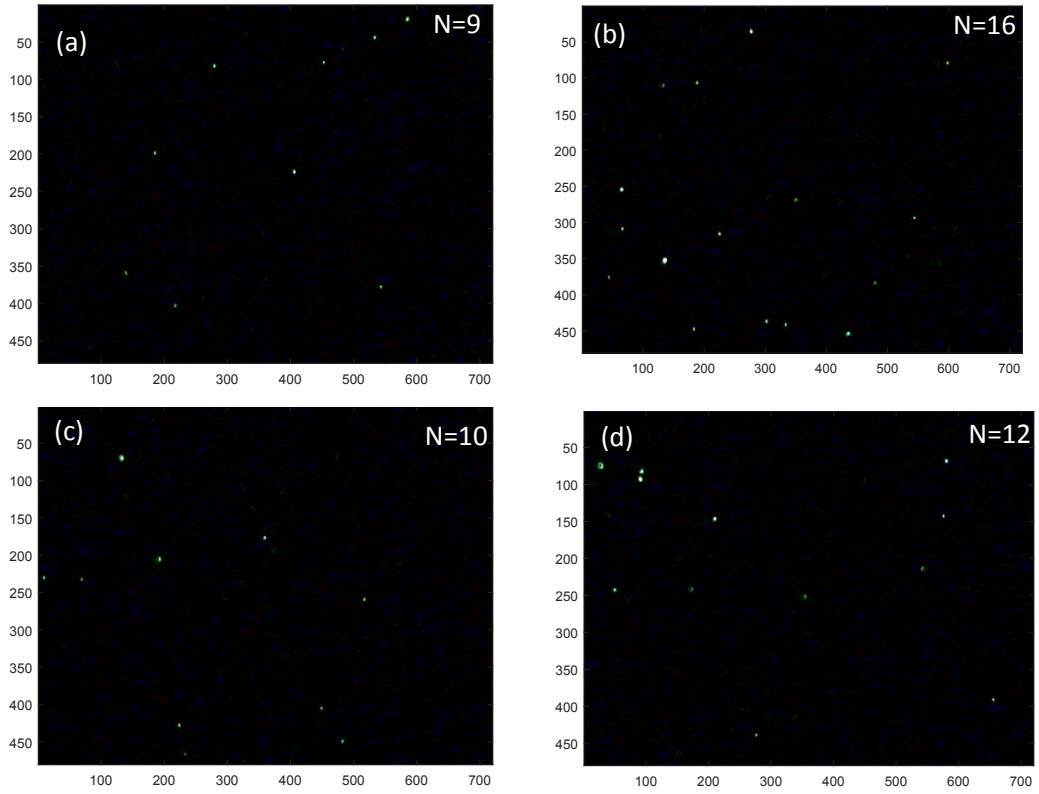

Figure S2: Representative picture frames taken in the 300-µm section of the microfluidic channel containing the particle suspension used in the trapping experiments, using a 40× objective lens. N, represent the number of particles in each frame. Each picture frame is of size 720 × 480 pixels. (1 pixel= 0.42 µm)

The number of particles (N) in each frame was counted manually. Due to the confined thickness of the channel (10 µm), and bright fluorescent signals from the particles, we could exactly count all the particles present in different planes along the z axis of the channel (Fig. 1a). Figure S2 shows the histogram of the number of particles per frame for 46 different frames collected from different portions of the channel along the x axis (Fig. 1a). The average number of particles was found to be 11±3 (mean±standard deviation). This was then used to calculate the concentration of the particles in the suspension as follows:

The volume of the channel section in a single picture frame (width=293 µm, length=202 µm; measured using optical microscope) is given as

Volume of the channel section = 293 µm×202 µm ×10µm = $5.9 \times 10^{5} \mu m^{3} = 5.9 \times 10^{-7} ml$

Concentration = average number of particles per frame/ volume of the channel section $\approx 1.9 \times 10^{7}\ particles/ml$

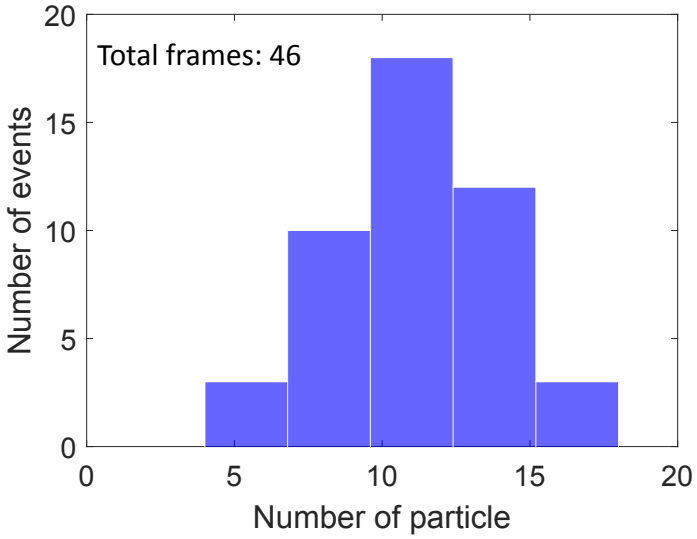

Figure S3 Histogram of the number of particles/frame observed in the 300-µm section of the microfluidic channel filled with 410 nm polystyrene particle suspension.