A microfluidic sensor that maps the velocity field around an oscillating microsphere

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Abstract

Optical trapping is a well established technique that has been widely used to noninvasively manipulate micro- and nano-sized objects [1-4]. Its combination with microfluidics provides novel analytical and sensing capabilities [5-9].

Here we show a novel experimental and theoretical approach on how an optically trapped microsphere can be used as an ultrasensitive detector for the induced motion of the medium surrounding a second oscillating microparticle. Fluidic vibrations created by the source (an optically trapped silica particle set to oscillate in a dipole-type mode) are detected by another twin silica particle independently trapped and located in the vicinity of the source (Fig.1a). Fourier analysis of the motion of the detecting particle at different points in space and time renders the velocity map around the oscillating microsphere (Fig.1b). The combination with acoustic and microfluidic theoretical models reveal that the measured fields are dominated by microfluidic contributions. The concept introduced here opens the way for new detection methods (i.e. Nano-Position System (NPS)) able to provide location and recognition (due to the field pattern) of moving sources that may be applied to artificial micro-objects and also to living organisms, like cells and bacteria.

References

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Figures

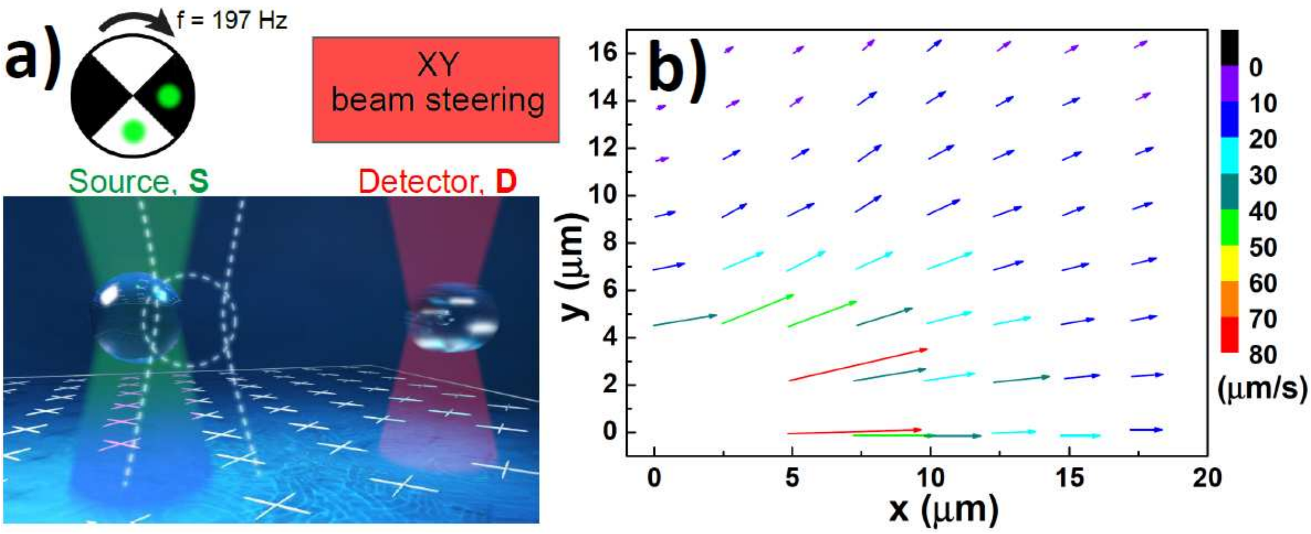

Fig.1 a) Schematic of our experiment: 2 SiO_2 particles of 0.88 μm radius in water are trapped in 2 independently controlled optical traps. The source oscillates with f = 197 Hz. b) Direction and magnitude of the velocity field measured experimentally.