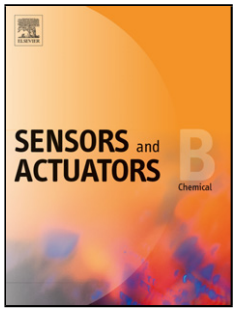

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A microfluidic platform for trapping, releasing and super-resolution imaging of single cells

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Key words:

Hydrodynamic trapping; Particle manipulation; Single cell analysis; Super-resolution imaging; Embryonic stem cells.

Highlights:

- Efficient, reliable and long-term trapping of single particles and cells.
- Selective releasing or retrieving trapped particles/cells.
- A stable platform for super-resolution imaging at a near molecular resolution.
- Study of mouse embryonic stem cells using photoactivated localisation microscopy.
- Identify centromeres of ~ 200 nm size with a precision of < 15 nm.

Abstract

A multi-layer device, combining hydrodynamic trapping with microfluidic valving techniques, has been developed for on-chip trapping, releasing and manipulation of single cells and particles. Such a device contains a flow layer with trapping channels to capture single particles or cells and a control layer with valve channels to selectively control the trap and release processes. Particles and cells have been successfully trapped and released using the proposed device. The device enables the trapping of single particles with a trapping efficiency of greater than 95%, and has the advantage that single particles and cells can be trapped, released and manipulated by simply controlling corresponding valves. Moreover, the trap and release processes are found to be compatible with biological samples like cells. Our device allows immobilising of large numbers of single cells in a few minutes, significantly easing the experiment setup for single-cell characterisation and offering a stable platform for both single-molecule and super-resolution imaging. Proof-of-concept super-