possibly reaching the effective size of the exciton in a QD in the near future. As this size is typically in the range of several nanometres, the FWHM might soon be limited by the QD itself. Record measurements might therefore be expected not with QDs but instead with other two-level systems such as colour centres or single atoms. Eventually, one may even optically resolve details of an excitonic wavefunction in a QD.

The range of applications of STED and RAP nanoscopy are likely to be complementary. While STED, STORM and all other incoherent nanoscopy[3] have been proven to be essential tools for super-resolution optical imaging in physiology, biology and medicine, it is unlikely that RAP nanoscopy will play a similar role in these fields. This is because RAP needs to operate at low temperatures (4 K so far, but with prospects of reaching 50 K (ref. [6])) to preserve coherence. At these temperatures, cryo-electron microscopy plays an important role in physiological applications and gives, of course, far better resolution than STED. The strength of STED lies in low-invasive, room-temperature imaging of (live) biomedical samples. In contrast, the straight-forward range of applications of RAP nanoscopy lies in the fields of quantum optics and solid-state physics. Controlling the state of a QD coherently with nanometre spatial resolution might become an important tool for fundamental investigations in quantum optics. Research on the physics of single QDs, colour centres or atoms might become easily possible even within a dense assembly of quantum emitters. ❐

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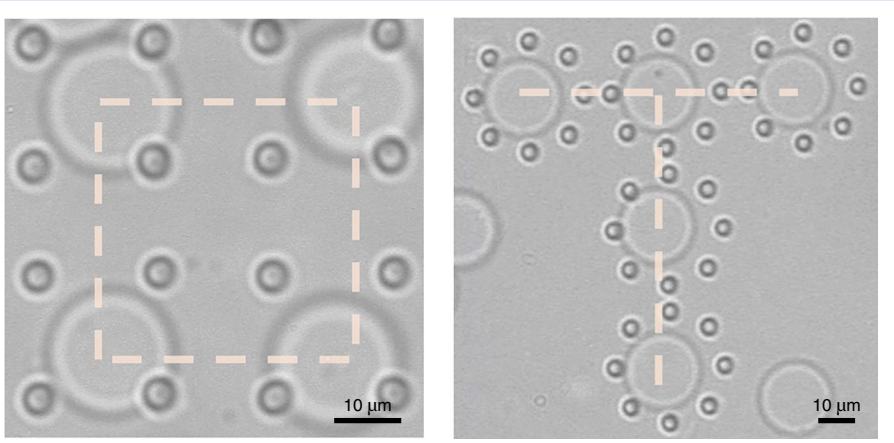
OPTOFLUIDICS

Instant trap formation

In biomedical and biochemical research, traps in the channels of a microfluidic chip are often used to capture target microparticles or cells of interest. However, the usual form of hydrodynamic traps come with several limitations. First, many microparticles or cells are prone to bypass the trap structures because the hydraulic resistance of the microtraps is larger than that of the free microchannel, resulting in a low trapping efficiency (<10%). Second, hydrodynamic traps are of a fixed design and thus the creation of a tunable trap array with a controllable size and geometry cannot be realized. Third, trapping of multiple cells or particles is not possible. To overcome these technological challenges, Bing Xu and co-workers from China and Japan have now developed a trapping scheme called real-time two-photon-lithography in controlled flow (TPL-CF), which effectively writes traps in situ using a laser (*Lab on a Chip* https://doi.org/10.1039/c7lc01080j; 2017).

The approach works as follows. A microchip is fabricated using polydimethylsiloxane (PDMS) via a standard soft lithography technique. In initial trapping experiments with silica microparticles, the height of the microchannel was designed to be about 24 μm to ensure the capture of only a single silica particle (20 μm in diameter) by each trap. The PDMS microchannel was then covered with a cover glass. The silica particles were mixed with a liquid photocurable resin and then injected into the microchip.



Credit: RSC

A charge-coupled device (CCD) camera was used to image the target silica particles for selective trapping. After stopping the liquid resin flow, a femtosecond laser operating at a central wavelength of 800 nm, repetition rate of 80 MHz and a pulse duration of 75 fs irradiated the area around the target particles to create the trapping pillars (pictured; left). Finally, the unexposed regions of resin were washed away using alcohol solution. To fabricate a four-pillar trap structure it only took 400 ms in total, including a time interval of 10 ms for moving the fabrication positions from one step to the next. The capture efficiency was nearly 100%.

The TPL-CF scheme is superior to conventional trapping methods because it can create arbitrary patterned arrays of single-particle traps as desired to allow trapping of multiple particles (pictured; right). The authors expect that the technique will find a wide range of applications including microparticle trapping and single-cell analysis as well as the creation of optofluidic microlenses for imaging and cell counting.

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