Smallest man-made cell pump

BBC

Scientists have revealed the smallest man-made pump ever built - the size of a human red blood cell.
The team of US and Chinese researchers used ultra-fast laser pulses to create tunnels in glass rods thinner than a human hair.

The glass walls of these tunnels can conduct electricity. The scientists powered their minuscule fluid pump by "switching" this conduction on and off.

They describe the advance in the journal Nature Nanotechnology.

The developers say the pump could be used to inject tiny amounts of a drug into single cells or to take samples from cells that may be diseased or infected.

The technique relies on the ability of glass, which is a well-known insulator, to become a "temporary conductor" of electricity.

"When you go down to the nanoscale, the world doesn't behave as we're used to," explained Alan Hunt from the University of Michigan, who led the research team.

He and his colleagues used the laser technique to etch out a narrow tunnel, 500-600 billionths of a metre (500-600 nm) in diameter, in the glass tube, one end of which was blocked to form a tip.

The team then filled the channel with an electrically conducting fluid, creating a "liquid wire".

At these very small scales, and in the presence of a strong electric field, the glass tip temporarily acted as a conductor, carrying current from the liquid to the pump.

When the current was reversed, the glass tip returned to being an insulator.

The continuous application and reversal of this process powered the pump mechanism, which was capable of controlling the flow of liquid at rates as low as a thousandth of a trillionth of a litre per second.

The process by which a current can be induced at nanoscales in a material which doesn't normally conduct electricity is known as "dialectic breakdown". It causes a change in the material which allows a spark to pass through it.

Many "nanodevices" are made from glass and this novel technique eliminates the need to incorporate conductive metal materials, which is very difficult to do with precision at such tiny scales.

These new glass electrodes are thought to have great potential in the manufacture of microscopic machinery for use in future medical treatments.

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