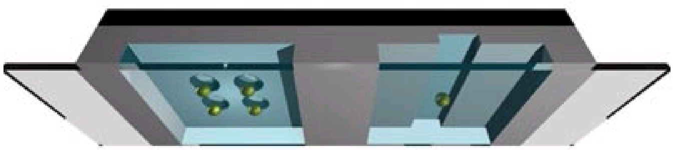
Electrostatic trap catches tiny particles

Oct 6, 2010 3 comments



The mechanism underpinning electrostatic tweezers

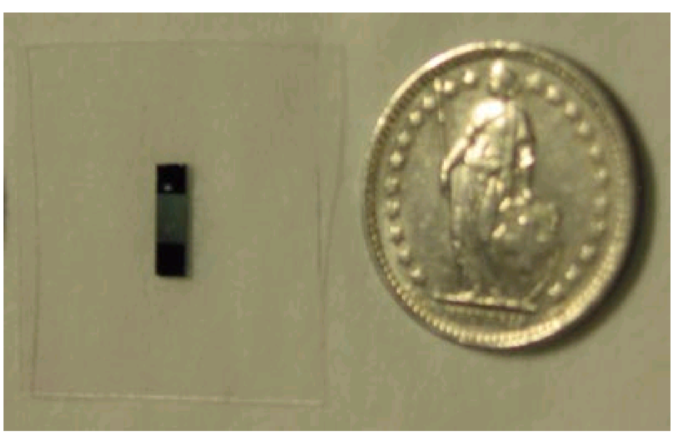
Researchers in Switzerland have demonstrated an innovative way of trapping tiny objects using electrostatic fields. The device could allow scientists to scrutinize much smaller biological molecules than is possible with the more established trapping technique known as "optical tweezers".

The ability to hold individual molecules in fixed positions can allow scientists to look in unprecedented detail at certain chemical processes and how single particles evolve over time. For instance, it can allow single binding events to be distinguished in chemical reactions, and it enables biologists to study processes occurring within basic biological structures. Engineers are also interested in these tools because they can enable them to fashion nanostructures with high precision.

Currently, the most popular trapping technique is optical tweezing, which works by steadying particles with beams of laser light. Since their invention about 40 years ago this technique has been used with great success in biophysics, helping researchers to unravel the complex elasticity and folding dynamics of DNA, for instance. But, because optical tweezers struggle to hold on to objects that are significantly smaller than the wavelength of light, they cease to work for objects that are smaller than 100 nm.

Charge rather than size

Now, a group at ETH Zurich has developed an alternative mechanism for trapping particles that does not suffer from the same limitation. The device works by suspending particles within an electrostatic field, whereby a particle's susceptibility to becoming trapped is dependent on its charge rather than its size.



The device

The device is 2 × 4 mm in its 2D profile, and comprises two parallel glass plates separated by a thin film of fluid, where one of these plates is flat while the other has little indentations on the surface.

Glass surfaces are negatively charged when in contact with water and, since like charges repel, a negatively charged object in the gap feels strong repulsions from both the top and the bottom walls causing it to "wander around" in the gap.

However, when a particle glides past an indentation it experiences a decreased push from the walls causing it to remain at that spot. "Once there, the object hovers in space for several hours, giving us plenty of time to study its behaviour," explains Madhavi Krishnan, lead author of the related research paper.

Assembling arrays

The researchers have already tested their device by trapping several types of particles with diameters of just tens of nanometres, including gold nanoparticles and polymer beads. This concept could open a number of opportunities for biomolecular science, especially because it provides a way to sort proteins and macromolecules using an external driving force. It might also enable researchers in the physical and materials sciences to assemble rewriteable arrays of metal and dielectric objects for applications in photonics.

> Once there, the object hovers in space for several hours, giving us plenty of time to study its behaviour.
>
> **Madhavi Krishnan**

One major limitation of the device, as described in a related commentary article in *Nature*, is that the trapped particles remain at fixed locations that cannot be changed at will, as can be done with optical trapping. One other drawback is that the trapping mechanism requires extremely low salt concentrations in the particle carrying liquid to avoid trapping the wrong particles. Given that biological fluids tend to have high salt concentrations this might restrict applications.

Krishnan could not provide a timeframe for the commercialization of her group's device, but she says the relative simplicity of fabrication and ease of operation are big advantages.

The research is described in a letter in this week's *Nature*.

About the author

James Dacey is a reporter for *physicsworld.com*

3 comments

Comments on this article are now closed.

1 **reader01**
Oct 7, 2010 1:59 PM

Is not it possible to change particles in the trap by simply changing of electric charge at tra
these particles not electricaly charged?

Offensive? Unsuitable? Notify Editor

2 **haha75**
Oct 17, 2010 12:16 PM

fashion

Offensive? Unsuitable? Notify Editor

3 **falas44**
Oct 20, 2010 11:59 AM

http://www.famalegoods.com