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Article Detail

Engineering and Physical Sciences Research Council Nano-machines Achieve Huge Mechanical Breakthrough

A major advance in nanotechnology with far-reaching potential benefits in medicine and other fields is to be announced at this year's BA Festival of Science in Dublin.

Scientists have built molecules that can, for the first time ever, move larger-than-atom-sized objects. Constructing molecular machines capable of performing relatively large-scale mechanical tasks has never been achieved before.

Now, in an unprecedented breakthrough, chemists at Edinburgh University have used light to stimulate man-made molecules to propel small droplets of liquid across flat surfaces and even up 12-degree slopes against the force of gravity. This is equivalent to tiny movements in a conventional machine raising objects to over twice the height of the world's tallest building.

This significant step could eventually lead to the development of artificial muscles that use molecular nano-machines of this kind to help perform physical tasks. Nano-machines could also be used in smart materials that change their properties (e.g. volume, viscosity, or conductivity) in response to a stimulus. They could even control the movement of drugs

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around the body to the exact point where they are needed.

David Leigh, Forbes Professor of Organic Chemistry and EPSRC Senior Research Fellow, and his colleagues have achieved their breakthrough by harnessing a natural biological mechanism called Brownian motion (the random movement of molecules caused by collisions with molecules around them). This has involved controlling (or biasing) Brownian motion so that molecule movements are no longer completely random.

The team has developed a way of covering a gold surface with specially engineered molecules. When stimulated by ultra-violet light, the components of these molecules change position (this is because a chemical reaction takes place in one part of the molecule that causes it to repel another part). These changes in position dramatically alter the surface tension of a droplet of liquid placed on the gold surface and in this way produce enough energy to move the droplet a distance of up to a millimeter. It may be the tiniest of movements but in the emerging discipline of nanotechnology this represents a giant technological leap forward.

David Leigh will be discussing his work and showing videos of droplet movement during his talk at the festival Sept. 7. A detailed report has also been published in the latest edition of Nature Materials ('Nanoshuttles move droplets uphill'; Vol. 4, pp.704-710, 2005).

This year's BA (British Association for the Advancement of Science) Festival of Science takes place in Dublin from Sept. 3 through 10. The event is one of the UK's biggest science festivals and attracts around 400 of the best scientists and science communicators from home and abroad who reveal the latest developments in research to a general audience. For more information, visit www.the-ba.net.

The Engineering and Physical Sciences Research Council (EPSRC) is the UK's main agency for funding research in engineering and the physical sciences.

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