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Scientists give insight into movement of molecules

Scientists at the University of Sheffield have made an exciting breakthrough in the control of the movement of single molecules. The findings represent a significant step forward in the field of molecular nanotechnology, which requires such control to achieve self-assembling nano-machines. This could potentially lead to the development of a method to send artificial drugs to their targets, or the creation of self-healing structures which could naturally repair tears in a surface.

The research findings, published in the journal ACS Nano online on 23 September 2009, have demonstrated that by tailoring the nature of the surface upon which the molecules are moving, they can be made to move in a given direction, without the need for an external influence.

At present, the control of molecules relies on external intervention. These findings reveal how and why a molecule chooses to move in a given direction, which provides scientists with a new technique to bring molecules together. The molecules could then form more complicated structures, or could even be used for the creation of self-assembling molecular machines.

The research team found that when a molecule chain touches a surface which repels water, for example the material an umbrella is made from, it flattens itself out, with the majority of the molecule being in contact with the surface. However, when the molecules touch a surface which attracts water, only small parts of the molecule are in contact with the surface, with the rest of the molecule chain being spread out. The research shows that on a surface which has both these extremes, the molecule chain shows directed movement towards the surface gradient which attracts water.

Dr Mark Geoghegan, from the Department of Physics and Astronomy at the University of Sheffield, who led the research team, said: "To create nano-structures we currently use expensive machines to move the molecules where we need them to go. Our research has developed a self-contained structure that can direct molecules to go - quite rapidly - in specific directions. This is a significant breakthrough for the control of molecules, which is an important task for nanotechnologists.

"By understanding how to make these molecules move in a given direction, we have the potential to create structures that allow molecules to get to a target. If we are lucky this could have implications in many technologies such as coaxing cells to move and grow in given directions, which would have huge implications for the treatment of paralysis."

Notes for Editors: This work was funded by the EPSRC and has been published in the journal online ACS Nano on 23 September 2009 : P. Burgos, Z. Zhang, R. Golestanian, G. J. Leggett, and M. Geoghegan "Directed single molecule diffusion triggered by surface energy gradients" ACS Nano in press.

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