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World First to Provide Building Blocks for New Nano Devices

Scientists at The University of Nottingham have made a major breakthrough that could help shape the future of nanotechnology, by demonstrating for the first time that 3-D molecular structures can be built on a surface.

The discovery could prove a significant step forward towards the development of new nano devices, such as cutting-edge optical and electronic technologies and even molecular computers.

In a paper, published in the journal Nature Chemistry, the team of chemists and physicists at Nottingham has shown that by introducing a 'guest' molecule they can build molecules upwards from a surface rather than just 2-D formations previously achieved.

A natural biological process known as 'self-assembly' meant that once the scientists introduced other molecules on to a surface their host then spontaneously arranged them into a rational 3-D structure.

Professor Neil Champness said; "It is the molecular equivalent of throwing a pile of bricks up into the air and then as they come down again they spontaneously build a house.

"Until now this has only been achievable in 2-D, so to continue the analogy the molecular 'bricks' would only form a path or a patio but our breakthrough now means that we can start to build in the third dimension. It's a significant step forward to nanotechnology."

Previously, scientists have employed a technique found in nature of using hydrogen bonds to hold DNA together to build two-dimensional molecular structure.

The new process involved introducing a guest molecule -- in this case a 'buckyball' or C60 -- on to a surface patterned by an array of tetracarboxylic acid molecules. The spherical shape of the buckyballs means they sit above the surface of the molecule and encourage other molecules to form around them. It offers scientists a completely new and controlled way of building up additional layers on the surface of the molecule.

The work is the culmination of four years' of research led by Professors Champness and Beton from the School of Chemistry and the School of Physics and Astronomy, which has been funded with a total of £3.5 million from the Engineering and Physical Sciences Research Council.

The research paper is the second significant breakthrough to be reported by the team in recent weeks. In September, a paper in Nature Communications revealed they had demonstrated for the first time the way in which an irregularly shaped molecule is adsorbed on a surface. It represents a step towards being able to harness the potential of these molecules, which have extremely useful properties, by organizing them to form structures. They could offer a way of building new data storage devices that are orders of magnitude smaller than their existing silicon-based counterparts.