Controlled disorder -- scientists find way to form random molecular patterns

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(PhysOrg.com) -- Scientists at The University of Nottingham have discovered a way to control how tiny flat molecules fit together in a seemingly random pattern.

The researchers have been studying molecules which resemble tiny rhombus/diamond shaped tiles, with a side length of around 2 nanometres — 2 billionths of a metre.

The fundamental research, published in the prestigious journal *Nature Chemistry*, has shown that they can prompt the 'tiles' to form a range of random patterns by adjusting the conditions in which the experiment is conducted.

Lead author Dr Andrew Stannard, in the University's School of Physics and Astronomy said: "To construct some sort of nanoscale device comprised of molecules, one needs to understand how those molecules will interact with one another.

"Typically, a useful device would be one in which the molecules arrange themselves in some perfectly ordered, regular manner. What we have studied here is almost the complete opposite — we have purposely tried to make the assemblies of molecules as random as possible.

"However, if we can gain a complete understanding of how randomness and disorder arises in these types of molecular structures, we can better understand how to eradicate that disorder when we want to create something functional."

Tilings of various geometrical shapes have interested scientists, mathematicians, and artists for centuries, and a wide range of tilings can be seen adorning many medieval architectural structures, as well as for practical purposes in our more modern kitchens and bathrooms.

But tile effects occur naturally within nature and science too and tilings of rhombuses are of particular interest to physicists, mathematicians and computer scientists because of their ability to form both periodic (regular, repeating patterns) and nonperiodic (random) patterns.

The Nottingham scientists have demonstrated for the first time that the generation of molecular rhombus tilings with varying degrees of orderliness — some very random, some very ordered — can be achieved by varying the conditions of the experiment in which they are created.

The achievement is all the more remarkable considering the range of experimental conditions in which this can be achieved is extremely narrow, requiring the scientists to achieve a delicate balance between energy and entropy — the subjects of the first and second laws of thermodynamics, some of the fundamental laws of physics and, in the case of entropy, are linked to order and disorder within a thermodynamic system.

Provided by University of Nottingham