Atom weaving breakthrough hailed

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Weaving threads of atoms into star-shapes could produce lighter, stronger plastics, according to scientists.

Researchers at the University of Edinburgh have managed to tie molecules into complex knots which they say could give materials "exceptional versatility".

Working on the nanoscale, which is 80,000 times smaller than a hair's breadth, the team has woven threads of atoms into the shape of five-point stars, creating building blocks of materials which are flexible and potentially shock absorbent. Each of the atom threads tied together is 160 atoms in length and measures a 16-millionth of a millimetre.

Scientists hope the new molecules, known as pentafoil knots, will mimic the characteristics of complex knots found in proteins and DNA, which help to make some substances elastic. In natural rubber, 85% of its elasticity is caused by knot-like structures in its molecule chain.

The team, which has been working with researchers from the University of Jyvaskyla in Finland, said it is the first time a knot has been created with five crossing points, as until now only the simplest type - a trefoil, with three points - has been achieved by scientists.

They claim that being able to produce materials with a specific number of entanglements, rather than the "random" mixture that occurs in today's plastics and polymers, could allow them to exercise greater control when designing materials.

Using a technique known as self-assembly, the researchers produced a chemical reaction in which atoms were chemically programmed to spontaneously wrap themselves up into the desired knot. This could make it easier for scientists to observe and understand how entanglements influence a material's properties.

Principal researcher David Leigh, Forbes Professor of organic chemistry at the University of Edinburgh, said: "It's very early to say for sure, but the type of mechanical cross-linking we have just carried out could lead to very light but strong materials - something akin to a molecular chain mail.

"It could also produce materials with exceptional elastic or shock-absorbing properties because molecular knots and entanglements are intimately associated with those characteristics. By understanding better how those structures work - and being able to create them to order - we should be able to design materials that exploit those architectures with greater effect."

The research, funded by the Engineering and Physical Sciences Research Council, is published in Nature Chemistry journal.