Chemists create world's most complex molecular knot

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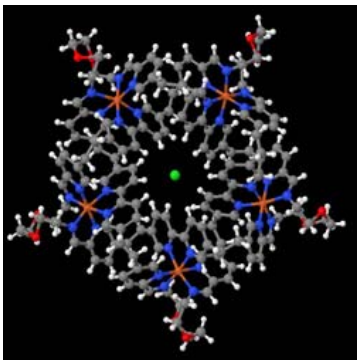

A pentafoil molecular knot create in the laboratory. It is the most complex artificially created knot ever made.

A research team headed by Professor David Leigh of the University of Edinburgh, U.K., and Academy Professor Kari Rissanen of the University of Jyväskylä, Finland, have made the most complex molecular knot to date, as reported in Nature Chemistry.

Knots can be found in DNA, proteins and even in the molecules that make up man-made plastics, where they often play an important role in the substance's properties (for example, 85% of the elasticity of natural rubber is due to knot-like entanglements in the rubber molecules chains).

However, deliberately tying molecules into well-defined knots so that these effects can be studied is extremely difficult. Up to now, only the simplest type of knot—a trefoil knot—had been prepared by scientists. Now Professor David Leigh's team at the University of Edinburgh together with Academy Professor Kari Rissanen at the University of Jyväskylä have succeeded in preparing and characterizing a more complex type of knot—a pentafoil knot (also known as a cinquefoil knot or a Solomon's seal knot)—a knot which looks like a five-pointed star.

Remarkably, the thread that is tied into the star-shaped knot is just 160 atoms in length—that is about 16 nm long. The Edinburgh researchers used a technique known as "self-assembly" to prepare the knot in a chemical reaction. The building blocks are chemically programmed to spontaneously wrap themselves up into the desired knot. Making knotted structures from simple chemical building blocks in this way should make it easier to understand why entanglements and knots have such important effects on material properties and may also help scientists to make new materials with improved properties based on knotted molecular architectures.

A synthetic molecular pentafoil knot

Professor David Leigh's team at the University of Edinburgh

Link to the rotating pentafoil knot

Academy of Finland