DNA 'tricked' to act as nano-building blocks

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(PhysOrg.com) -- McGill researchers have succeeded in finding a new way to manufacture nanotubes, one of the important building blocks of the nanotechnology of the future. Their building material? Biological DNA.

A team of researchers, led by Prof. Hanadi Sleiman in collaboration with Prof. Gonzalo Cosa, both of McGill University's Department of Chemistry, can now tailor different geometries, rigidities and porosities into these nanotubes through the clever introduction of non-DNA molecules. This work is to be reported in the April 13 edition of the journal Nature Nanotechnology.

Nanotubes are infinitesimally small, measuring six or seven nanometers across. (A nanometre, one-billionth of a metre, is one ten-thousandth the diameter of a human hair.) One of the important features of these tubes is their extreme length, at about 20,000 nanometres. While they are tiny, they offer an incredibly versatile potential to solve a number of key problems facing nanotechnology researchers. This includes the design of drug delivery vehicles, the manufacture of electronic nanowires, medical implants and scaffolds for solar energy conversion among others.

"It looks like our fabrication is in place," Sleiman said. "We are now looking at potential applications of these materials in drug delivery. It's too early to tell for sure, but this is certainly something worth exploring.

"DNA is an incredible scaffold for making nanotubes."

Nanotechnology's tremendous potential to affect social and economic development is dependent on scientists first being able to make the necessary molecules and materials. To make this happen, nanotechnologists are now using nature's code of life, DNA. With its simple A, T, C and G alphabet, DNA is able to direct the formation of an astounding array of proteins that work collectively to create life. It is precisely this property of chemical information stored in DNA that nanotechnology is now exploiting.

In this case, DNA strands are programmed to assemble into complex one- two- and three-dimensional structures. By incorporating synthetic molecules into such strands of DNA, the Sleiman group provided nature's workhorse with further specific dialed-in structural and functional properties.

Using this method, Faisal Aldaye, Peggy Lo, Pierre Karam and Chris McLaughlin in the Sleiman and Cosa laboratories have demonstrated the first examples of DNA nanotubes with deliberately controlled geometry. Remarkable triangular and square-shaped tubes spontaneously form using these new techniques.

These nanotubes offer great potential, for example, for the construction of metal nanowires of different geometries. The DNA tube can be used as a mold into which metals are grown, creating microscopically thin wires that may have a wide variety of applications.

The team has also shown how these nanotubes can be created in an ‘open', single-stranded form and ‘closed' double-stranded form. These forms will be especially interesting for the encapsulation and selective release of drugs near the site of diseased cells.

Provided by McGill University (news : web)