Purdue University

RNA Could Form Building Blocks for Nanomachines

Microscopic scaffolding to house the tiny components of nanotech devices could be built frc the same substance that shuttles messages around a cell's nucleus, reports a Purdue Univer research group.

By encouraging ribonucleic acid (RNA) molecules to self-assemble into 3-D shapes resembling spir triangles, rods and hairpins, the group has found what could be a method of constructing lattices on build complex microscopic machines. From such RNA blocks, the group has already constructed ar are several micrometers in diameter - still microscopically small, but exciting because manipulating controllable structures of this size from nanoparticles is one of nanotechnology's main goals.

"Our work shows that we can control the construction of three-dimensional arrays made from RNA b different shapes and sizes," said Peixuan Guo, who is a professor of molecular virology in Purdue's of Veterinary Medicine. "With further research, RNA could form the superstructures for tomorrow's nanomachines."

The paper, which Guo co-authored with Dan Shu, Wulf-Dieter Moll, Zhaoxiang Deng and Chengde I of Purdue, appears in the August issue of the journal Nano Letters.

Nanotechnologists, like those in Guo's group, hope to build microscopic devices with sizes that are measured in nanometers - or billionths of a meter. Because nature routinely creates nano-sized stru for living things, many researchers are turning to biology for their inspiration and construction tools.

"Biology builds beautiful nanoscale structures, and we'd like to borrow some of them for nanotechnc Guo said. "The trouble is, when we're working with such tiny blocks, we are short of tiny steam shov push them around. So we need to design and construct materials that can assemble themselves."

Organisms are built in large part of three main types of building blocks: proteins, DNA and RNA. Of three, perhaps least investigated and understood is RNA, a molecular cousin to the DNA that stores blueprints within our cells' nuclei. RNA typically receives less attention than other substances from r nanotechnologists, but Guo said the molecule has distinct advantages.

"RNA combines the advantages of both DNA and proteins and puts them at the nanotechnologist's disposal," Guo said. "It forms versatile structures that are also easy to produce, manipulate and eng

Since his discovery of a novel RNA that plays a vital role in a microscopic "motor" used by the bacte phi29 (see related story), Guo has continued to study the structure of this RNA molecule for years. I the "pistons" of a tiny motor his lab created several years ago, and members of the team collaborate previously to build dimers and trimers - molecules formed from two and three RNA strands, respecti Guo said the methods the team used in the past made their recent, more comprehensive constructi possible.

"By designing sets of matching RNA molecules, we can program RNA building blocks to bind to eac in precisely defined ways," he said. "We can get them to form the nano-shapes we want."

From the small shapes that RNA can form - hoops, triangles and so forth - larger, more elaborate st can in turn be constructed, such as rods gathered into spindly, many-pronged bundles. These struct could theoretically form the scaffolding on which other components, such as nano-sized transistors, sensors, could be mounted.

"Because these RNA structures can be engineered to put themselves together, they could be usefu industrial and medical specialists, who will appreciate their ease of engineering and handling," said Moll, a postdoctoral researcher in Guo's lab. "Self-assembly means cost-effective."

Moll, while bullish on RNA's prospects, cautioned that there was more work to be done before nano models could be built at will.

"One of our main concerns right now is that, over time, RNA tends to degrade biologically," he said. already working on ways to make it more resistant to degradation so that it can form long-lasting str

Guo said that though applications might be many years away, it would be most productive to take th long-term approach.

"We have not built actual scaffolds yet, just 3-D arrays," he said. "But we have built them from engin biological molecules, and that could help us bridge the gap between the living and the nonliving wor nanotech devices can eventually be built from both organic and inorganic materials, it would ease th in both medical and industrial settings, which could multiply their usefulness considerably."

This research was sponsored in part by the National Science Foundation, the National Institutes of I and the Department of Defense. Moll's postdoctoral research is funded by the Austrian Science Fun Erwin Schroedinger Fellowship.

Guo is affiliated with Purdue's Cancer Center and Birck Nanotechnology Center. The Cancer Cente just eight National Cancer Institute-designated basic research facilities in the United States, attempt cancer patients by identifying new molecular targets and designing future agents and drugs for effec detecting and treating cancer.

The Birck Nanotechnology Center is located in Purdue's new Discovery Park, located on the southw edge of campus. Programs include undergraduate teaching, graduate research and technology tran initiatives with industry partners. Scientists in biology, chemistry, physics and several engineering di participate in the research.

Weitere Informationen: www.purdue.edu
discoverypark.e-enterprise.purdue.edu/wps/portal/.cmd/cs/.ce/155/.s/4270/_s.1

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