Linking bio and nano...

an extended discussion 2004 - 2005

Construction of an imitating nano-motor driven by six ATP-binding RNAs of bacterial virus phi29

---Applications in Nanotechnology and therapy/diagnosis of cancers and viral infections

Peixuan Guo

Department of Pathobiology and
Purdue Cancer Center

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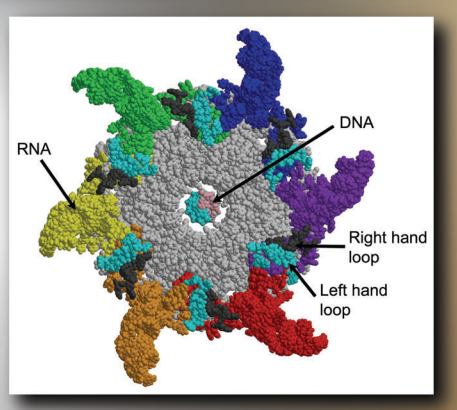

A switchable imitating DNA-packaging motor was constructed in the laboratory. The motor is driven by six synthetic ATP-binding pRNA (packaging RNA) molecules that bind to the connector and function in a manner similar to the driving of a bolt with a hex nut. Conformational change and sequential action of the RNA ensure continuous rotation of the motor, with ATP as energy.

A 5-mm DNA was packaged using this synthetic motor using one ATP to translocate two base pairs of DNA. The DNA-filled capsids were subsequently converted into infectious virus. Direct observation revealed that the motor can tow a bead more than 500 nm.

The 3D structures of pRNA/motor complex and the pRNA monomer, dimer and hexamer have been probed by photo affinity crosslinking, chemical modification interference, nuclease probing, cryo-AFM and computer modeling. pRNA's size and shape can be controlled and manipulated at will to form stable dimers, trimers and arrays for nanotechnological applications. The motor can be turned off and turned on again.

The formation of ordered structural arrays of the motor complex and its components and the ease of RNA dimer, trimer, and hexamer manipulation with desired shape and size make this motor system a promising tool for use as building block for nanodevice and/or for gene delivery. Efficient inhibition of the growth of cancer or cancer cell was demonstrated in cell cultures or animal models through the use of motor nanoparticle to deliver therapeutic siRNAs and/or ribozymes to breast cancer cells, human oropharyngeal epidermoid carcinoma KB cells, leukemia model T cells, lung cancer cells, or hepatitis B virus-infected cells.

Biography
Peixuan Guo

In 1987, Dr. Guo received his Ph.D. in Microbiology and Genetics in Dwight Anderson's lab at the University of Minnesota/School of Dentistry. His postdoctoral fellowships were with Enzo Paoletti in the Wadsworth Center of the New York State Department of Health in 1998 and as a visiting scientist with Bernard Moss at NIH. Dr. Guo joined Purdue University in 1990, and has been a full Professor of Molecular Virology since 1997. His current main research interested is in nanobiotechnology. His lab has been continuously supported by grants from NIH, NSF, and DOD. In recognition of his research efforts at Purdue, Dr. Guo was the recipient of an NIH First Award in 1992 and the "Pfizer Distinguished Faculty Award for Research Excellence" in 1995; the status of Purdue Faculty Scholar was conferred in 1998.

Ongoing research in his lab involves answering fundamental questions concerning the mechanisms of the phi29 DNA-packaging motor and the role of six pRNAs, and applying these findings to human health and nanotechnology, such as the engineering of pRNA and other motor components to be used as nanobuilding blocks and for array construction, and for gene and drug delivery for specific cell-targeting in the treatment of cancers and virus-related diseases.

Dr. Guo is an editor or editorial board member for six journals, including four in nanotechnology and bionanotechnology, and has been an advisor and honorary visiting professor of three foreign national research institutes and three foreign universities. He has published more than 70 original research papers in refereed journals including Science, PNAS, and Molecular Cell, more than ten reviews, and more than 100 conference reports. He has also chaired or been the keynote speaker at numerous symposia and international conferences. His work has been in the news by television (NBC, MS-NBC, and ABC), newspapers (Indianapolis Star and Washington Times), magazines (Scientific American), and online, including Space Daily, Science Daily, the NSF Newsletter, the Science website and many nanotechnology-related web sites. He has been invited multiple times to speak and contribute to document preparation for National Nanotechnology Initiatives (NNI) organized by NIH, NSF, NIST, NSET and the National Sciences & Technology Council, and to serve as a panelist to evaluate the medical research of the Army, Navy, Air Force and other Department of Defense programs.

For more information contact
Mark Lundstrom
lundstro@ecn.purdue.edu