BIOTECHNOLOGY

DNA Motor Programmed to Navigate a Network of Tracks

Applicable to the Development of Molecular Robots Manufactured in Nao- and Meso-Sized Space

Professor Hiroshi Sugiyama - Graduate School of Science, iCeMS
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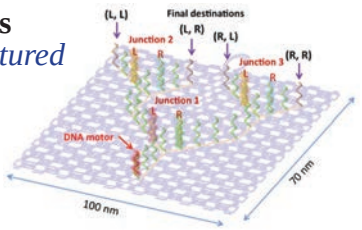
Dr. Shelley F. J. Wickham - the University of Oxford
Professor Andrew J. Turberfield - the University of Oxford



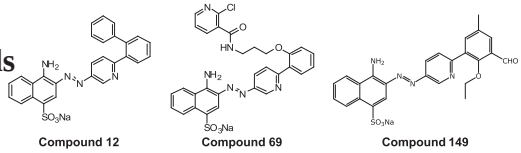
Expanding on their previous work with engines traveling on straight tracks, a team of researchers at Kyoto University and the University of Oxford have successfully used DNA building blocks to construct a motor capable of navigating a programmable network of tracks with multiple switches.

The research utilizes the technology of DNA origami, where strands of DNA molecules are sequenced in a way that will cause them to self-assemble into desired 2D and even 3D structures. In this latest effort, the scientists built a network of tracks and switches atop DNA origami tiles, which made it possible for motor molecules to travel along these rail systems. The team, including lead author Dr. Shelley Wickham at Oxford, expects that the work may lead to the development of even more complex systems, such as programmable molecular assembly lines and sophisticated sensors.

dx.doi.org/10.1038/NNANO.2011.253

Development of Novel Inhibitors for VCP, the Most Abundant ATPase, in Mammalian Cells

Professor Akira Kakizuka - Graduate School of Biostudies
Lecturer Seiji Hori - Graduate School of Biostudies

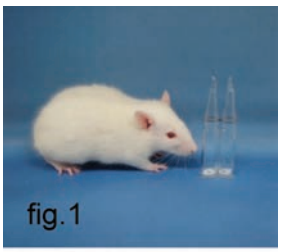


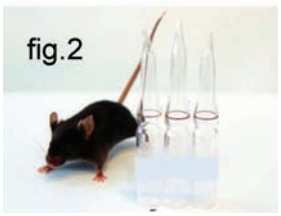
Valosin-containing VCP), which belongs to the AAA (ATPase associated with diverse cellular activities) proteins, has been shown to colocalize with abnormal protein aggregates, such as nuclear inclusions of Huntington disease and Machado-Joseph disease, and Lewy bodies in Parkinson disease. It is suggested that VCP may be a potential therapeutic target for the treatment of these neurodegenerative diseases. Prof. Akira Kakizuka and Dr. Hori synthesized novel naphthalene derivatives with VCP inhibitory activity. The naphthalene derivatives are able to regulate VCP activity and subsequently suppress the degeneration of neural cells. www.saci.kyoto-u.ac.jp/en/?cat=1

Birth of Baby Derived from Egg Fertilized with Freeze-Dried Sperm

Successful Long-term Preservation of Sperm by Freeze-drying

Dr. Takehito Kaneko, Lecturer - Graduate School of Medicine
Professor Tadao Serikawa - Graduate School of Medicine





The freeze-drying of sperm has been developed as a new preservation method where liquid nitrogen is no longer necessary. An advantage of freeze-drying sperm is that it can be stored at 4°C and transported at room temperature. We showed that the fertility of freeze-dried sperm could be maintained for 5 years without deterioration. Offspring with normal fertility were generated from oocytes fertilized with sperm freeze-dried in Tris-EDTA buffer. This is the first report to demonstrate the successful freeze-drying of sperm using this new and simple method for long-term preservation. Furthermore, freeze-dried samples can be temporarily stored at room temperature even in the event of a power failure, interruption to the liquid nitrogen supply or other emergencies caused by disasters such as earthquakes and typhoons. We strongly believe that the freeze-drying process provides a safe and economical preservation of valuable animal strains, and provides us with a new method of sperm preservation for bio-banking. dx.doi.org/10.1371/journal.pone.0035043

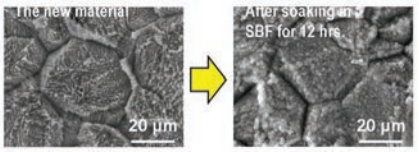
[fig1] Rat derived from fertilized oocytes with freeze-dried sperm stored for 5 years.
[fig2] Mouse derived from fertilized oocytes with freeze-dried sperm stored for 3 years.

MATERIALS

An Artificial Implant that Quickly and Strongly Bonds to Human Bone

Bioactive Apatite Nuclei Precipitated Titanium with Superior Osteo-Conductivity for Implants

Professor Takeshi Yao - Graduate School of Energy Science
Assis. Prof. Takeshi Yabutsuka - Graduate School of Energy Science



The whole surface of the material was rapidly covered with hydroxyapatite when soaked in simulated body fluid for 12 hrs.

Prof. Takeshi Yao and Assistant Prof. Takeshi Yabutsuka have invented a new type of titanium (Ti) for implants with micro pores in which nano Apatite Nuclei (AN) consisting of an amorphous calcium phosphate precipitate. The AN are highly effective at inducing hydroxyapatite (HA) from body fluid, and consequently this material demonstrates superior osteo-conductivity to conventional Ti in vivo. The whole surface of the material was rapidly covered with hydroxyapatite when soaked in simulated body fluid for 12 hrs. In an animal study, this material bonded to bone much more quickly and with greater strength than either simple Ti plate or Ti coated with HA in the conventional method. Superior adhesive strength was attained by a mechanical interlocking effect between HA formed in the pores which was oriented in various directions. The advantages of the new materials are: 1) Superior osteo-conductivity compared with conventional implant materials. 2) Easy and inexpensive to make. 3) Can enhance the osteo-conductivity of commercially available Ti plates. 4) Has the same mechanical strength and machining performance as commercially available Ti. 5) AN can be safely used in humans because they are elements found in natural bone. www.saci.kyoto-u.ac.jp/en/?p=1280

OTHERS

The Permoveh: A Personal Mobile Vehicle which can Easily Move in Small Spaces

An Innovative Mobile Vehicle Capable of Forward, Backward, Traverse and Diagonal Motion

Associate Professor Masaharu Komori - Graduate School of Engineering

Demand for personal vehicles is increasing. Mobility aids such as wheelchairs play an important role in the lives of aged or handicapped people. However, although they can move forward and backward, wheelchairs are not capable of traverse movement. Traverse motion often becomes necessary when, for example, the user of a wheelchair moves toward their bed in a hospital room or when they are in a crowded elevator. In such situations, the users have difficulty moving because wheelchairs are not able to move in a traverse direction.

Through his research, Associate Prof. Masaharu Komori has developed a new vehicle, the Permoveh (Personal mobile vehicle), in order to solve that problem. The Permoveh is able to move not only forward and backward direction, but also in a traverse direction. In addition, it is possible to move diagonally and turn. The Permoveh makes it easy to move in small spaces because of its highly advanced motion ability. This technology could also be applied to transportation vehicles used in factories or warehouses.

A New Criterion for Assessment of Free-Surface in Particle Methods

Accurate Tracking of Free-Surface in Particle Methods

Professor Hitoshi Gotoh - Graduate School of Engineering
Lecturer Abbas Khayyer - Graduate School of Engineering

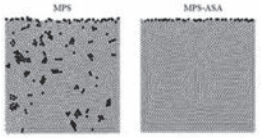


Fig.1

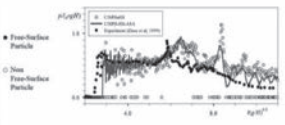


Fig.2

Prof. Hitoshi Gotoh and Lecturer Abbas Khayyer have proposed a new criterion for a more accurate and efficient assessment of free-surface in particle methods. The new criterion is simply based on the fact that a non-free-surface particle located inside the computational domain has a nearly symmetric distribution of neighboring particles. The efficiency of the new criterion has been shown by simulating a hydrostatic pressure calculation using both MPS and MPS with the Assessment of free-surface based on nearly Symmetric Arrangement of non-free-surface particles (MPS-ASA) methods (Fig. 1) and a dam break simulation by the CISPH-HS and CISPH-HS-ASA methods (Fig. 2). www.saci.kyoto-u.ac.jp/en/?p=930