

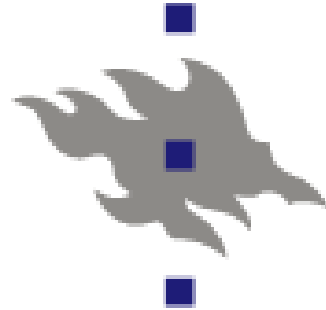
Nanoteknologia

Nanoteknologian runko

(Tai ainakin esitelmän)

- **Kuka mitä häh** Eli kuka tuo tyyppi edessä on ja miksi se puhuu nanoteknologiasta?
- **Mitä on nanoteknologia** Eli mistä se siis puhuu?
- **Tutkimuksen nykytilanne** Eli mitä nyt tehdään?
- **Lähitulevaisuuden sovelluksia** Eli mitä huomenna tehdään?
- **Drextech** Eli mitä ensi vuonna tehdään?
- **Lopetus** Eli joko päästään tuota heppua sietämästä?
Hippilarppikin on henkevämpää kuin tämä.

Kuka mitä häh?



<http://www.helsinki.fi/>



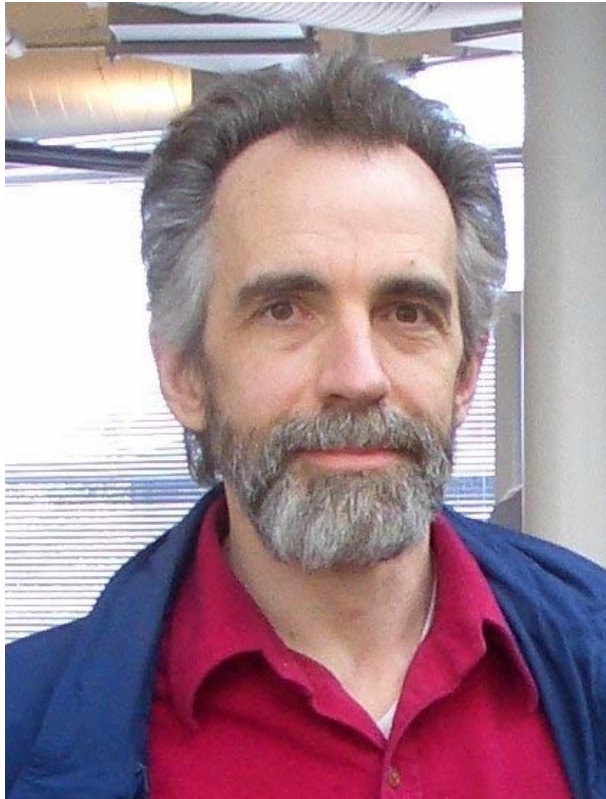
<http://www.transhumanismi.org/>



<http://www.piraattipuolue.fi/>

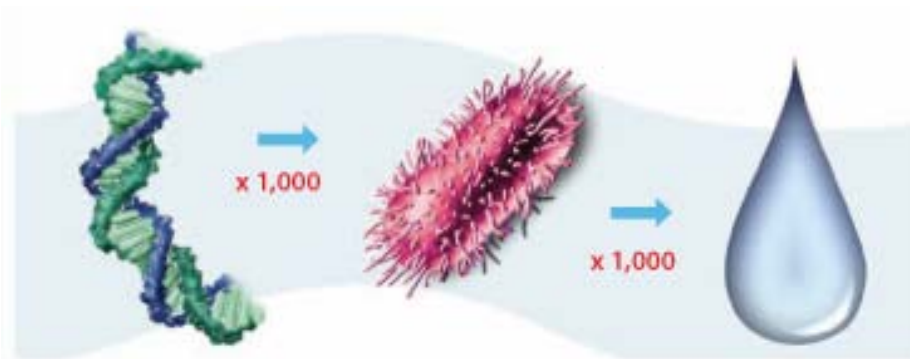
Mitä on nanoteknologia?

Mitä nanoteknologia on?



Vähän hankala kysymys

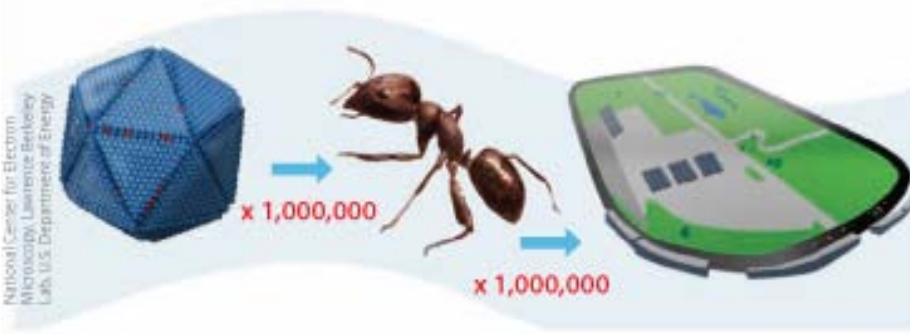
- Nanoteknologian tarkka määritelmä puuttuu
- ”Teknologia” ehkä kyseenalainen termi - tällä hetkellä paljolti perustutkimusta l. nanotiedettä
- Nano.gov: ”Nanoscience involves research to discover new behaviors and properties of materials with dimensions at the nanoscale which ranges roughly from 1 to 100 nanometers(nm).”
- Esim. hemoglobiinilla noin 5 nm halkaisija, DNA 2,5 nm



DNA 2.5 nanometers diameter	Bacterium 2.5 micrometers long	Large Raindrop 2.5 millimeters diameter
--	---	--



Single-walled Carbon Nanotube 1 nanometer diameter	Strand of Hair 100 micrometers diameter	House 10 meters wide
--	--	-----------------------------------



Nanoparticle 4 nanometers diameter	Ant 4 millimeters long	Indianapolis Motor Speedway 4 kilometers per lap
---	-------------------------------------	--

National Center for Electron
Microscopy, Lawrence Berkeley
Lab, U.S. Department of Energy

Vähän hankala kysymys

- Käytännössä yleisnimitys materiaaleja nanoskaalalla käsitteleville teknologioille
- Voivat olla hyvinkin erilaisia: robotiikka, biologia, kemia, materiaalfysiikka...
- Esim. Japanissa nanotutkimus keskittynyt voimakkaasti elektroniikka- ja materiaalipuoleen (2002)
- Tekee ehkä turhankin helpoksi väittää tekevänsä nanoteknologiaa (ja siten päästä nanohypestä osingoille)

Miksi ”nanoteknologia”?

- Yhteistä: nanoskaalan materiaalit toimivat eritavalla kuin suuremmalla, ominaisuudet erilaisia
- Esim. kvanttimekaniikan lait alkavat vaikuttaa
- Nanomateriaaleilla mm. suurempi pinta-ala kuin vastaavilla suuremman skaalan materiaaleilla, suurempi osa materiaalista vaikuttaa ympäröiviin aineisiin (esim. katalysoiden reaktioita)

Tutkimuksen nykytilanne

Nanoteknologia kansainvälisesti

- USA: National Nanotechnology Initiative: Bill Clintonin 2001 aloittama 497 miljoonan dollarin rahoituksella, 2009 budjetti 1,5 miljardia dollaria (960 miljoonaa euroa)
- EU: Seventh Framework Programme: "Nanosciences, nanotechnologies, materials & new production technologies" - 3,5 miljardia euroa 2007-2013 (580 miljoonaa euroa/vuosi)
- Japani: 2003 noin 700 miljoonaa euroa sen vuoden kurssilla

Nanoteknologia kansainvälisesti

- Kiina: 2006 aloitettu 15 vuoden "Medium- to Long-Term Plan for the Development of Science and Technology", tavoitteena "innovaatiosuuntautunut yhteiskunta" 2020, johtava valtio tieteessä ja teknologiassa 2050.
- Mm. neljä "tieteen megaprojektia": Kehitys- ja lisääntymisbiologia, proteiinitiede, kvanttitutkimus, nanoteknologia.

Nanoteknologia kansainvälisesti: USA

Table 4
Planned 2009 Agency Investments by Program Component Area
(dollars in millions)

	Fundamental Phenomena & Processes	Nanomaterials	Nanoscale Devices & Systems	Instrument Research, & Metrology, & Standards	Nano-manufacturing	Major Research Facilities & Instr. Acquisition	Environment, Health, and Safety	Education & Societal Dimensions	NNI Total
DOD	227.8	55.2	107.7	3.6	12.8	22.1	1.8		431.0
NSF	141.7	62.5	51.6	16.0	26.9	32.1	30.6	35.5	396.9
DOE	96.9	63.5	8.1	32.0	6.0	101.2	3.0	0.5	311.2
DHHS (NIH)	55.5	25.4	125.8	5.9	0.8		7.7	4.6	225.7
DOC (NIST)	24.5	8.5	22.7	20.9	15.3	5.7	12.8		110.4
NASA	1.2	9.8	7.7			0.2	0.1		19.0
EPA	0.2	0.2	0.2				14.3		14.9
DHHS (NIOSH)							6.0		6.0
USDA (FS)	1.7	1.3	0.7	1.1	0.2				5.0
USDA (CSREES)	0.4	0.8	1.5		0.1		0.1	0.1	3.0
DOJ				2.0					2.0
DHS			1.0						1.0
DOT (FHWA)	0.9								0.9
TOTAL	550.8	227.2	327.0	81.5	62.1	161.3	76.4	40.7	1,527.0

Lähitulevaisuuden sovellusalueet

- National Science Foundation: 2015 mennessä nanorakenteisten materiaalien myynti \$340 miljardia, nanoelektroniikka ja IT \$600 miljardia, nanolääketiede \$180 miljardia
- Sovellusalueita: instrumentit ja sensorit, tuotanto ja materiaalit, maanviljely ja ruuantuotanto, elektroniikka ja tietokoneet, lääketiede, energia, ylellisyystuotteet.

Lähitulevaisuus: instrumentit ja sensorit

- Havaintojen teko yhä pienemmiltä skaaloilta, yksittäistenkin molekyylien tasolla
- 2005 kehitteillä tapa kuvata elävien solujen sisuksia $50 >$ nanometrin resoluutiolla (näkyvä valo, infrapuna, ultravioletti)

Polymer Single-Nanowire Optical Sensors

Fuxing Gu,[†] Lei Zhang,[‡] Xuefeng Yin,[‡] and Limin Tong^{†*}

State Key Laboratory of Modern Optical Instrumentation, Department of Optical Engineering, and Institute of Microanalytical Systems, Department of Chemistry, Zhejiang University, Hangzhou 310027, China

Received April 30, 2008

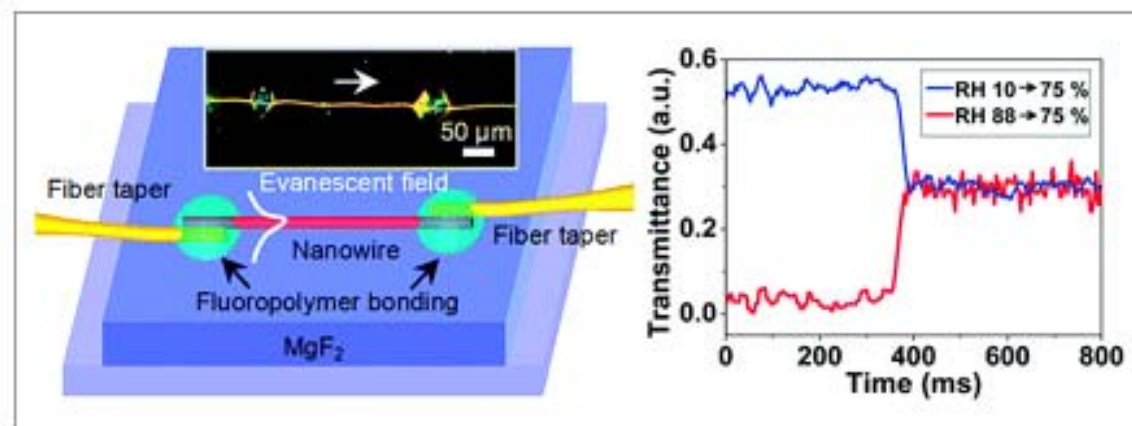
Revised June 16, 2008

Abstract:

We report highly versatile nanosensors using polymer single nanowires. On the basis of the optical response of waveguiding polymer single nanowires when exposed to specimens, functionalized polymer nanowires are used for humidity sensing with a response time of 30 ms and for NO₂ and NH₃ detection

down to subparts-per-million level. The compact and flexible sensing scheme shown here may be attractive for very fast detection

in physical, chemical, and biological applications with high sensitivity and small footprint.



Ultrasensitive Fluorescence Detection of Single Protein Molecules Manipulated Electrically on Au Nanowire

Suxian Huang[†] and Yong Chen^{*}

Department of Mechanical and Aerospace Engineering, California NanoSystems Institute, University of California, Los Angeles, California 90095

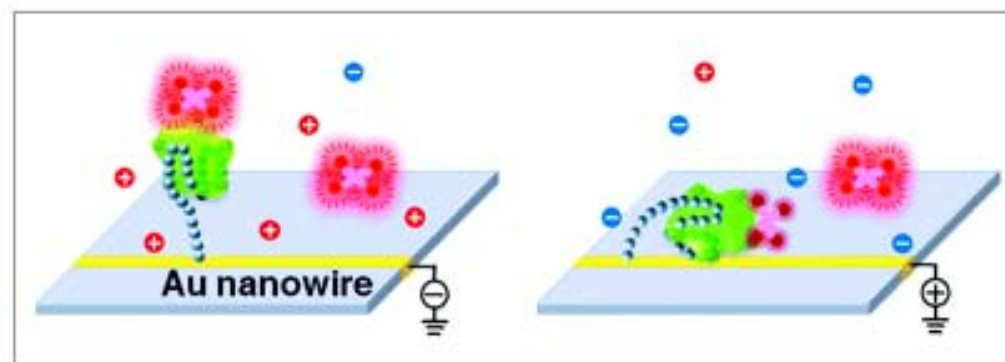
Received May 18, 2008

Revised June 25, 2008

Abstract:

Proteins assembled on an Au nanowire are manipulated by an electrical potential applied on the nanowire, which leads to the modulation of molecular fluorescence. The molecular modality can be unequivocally correlated with the modulated fluorescence, which enables the specific fluorescence from a single target protein to be unambiguously distinguished from background noise and nonspecific fluorescence.

As demonstrated through a thrombin assay, this simple method can significantly improve the sensitivity and specificity of the protein detection down to the single molecule level.

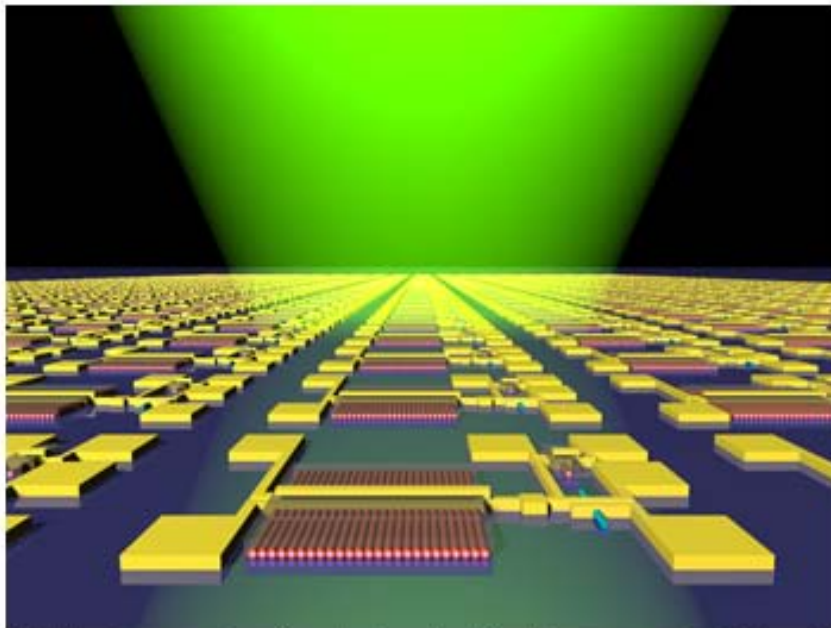


August 1, 2008

A First in Integrated Nanowire Sensor Circuitry

Contact: [Paul Preuss](#), 486-6249

Scientists at the U.S. Department of Energy's Lawrence Berkeley National Laboratory and the University of California at Berkeley have created the world's first all-integrated sensor circuit based on nanowire arrays, combining light sensors and electronics made of different crystalline materials. Their method can be used to reproduce numerous such devices with high uniformity.



Artist's impression of an integrated light sensor circuit based on nanowire arrays (Javey Group).

Academy of Sciences (PNAS).

Nanostructures made with specific chemical, electronic, and other properties have a number of advantages over the same materials in bulk. For example, a nanowire is an ideal shape for a light detector; being virtually one-dimensional, practically "all surface," a nanowire is not only highly sensitive to light energy, but its electronic response is greatly enhanced as well.

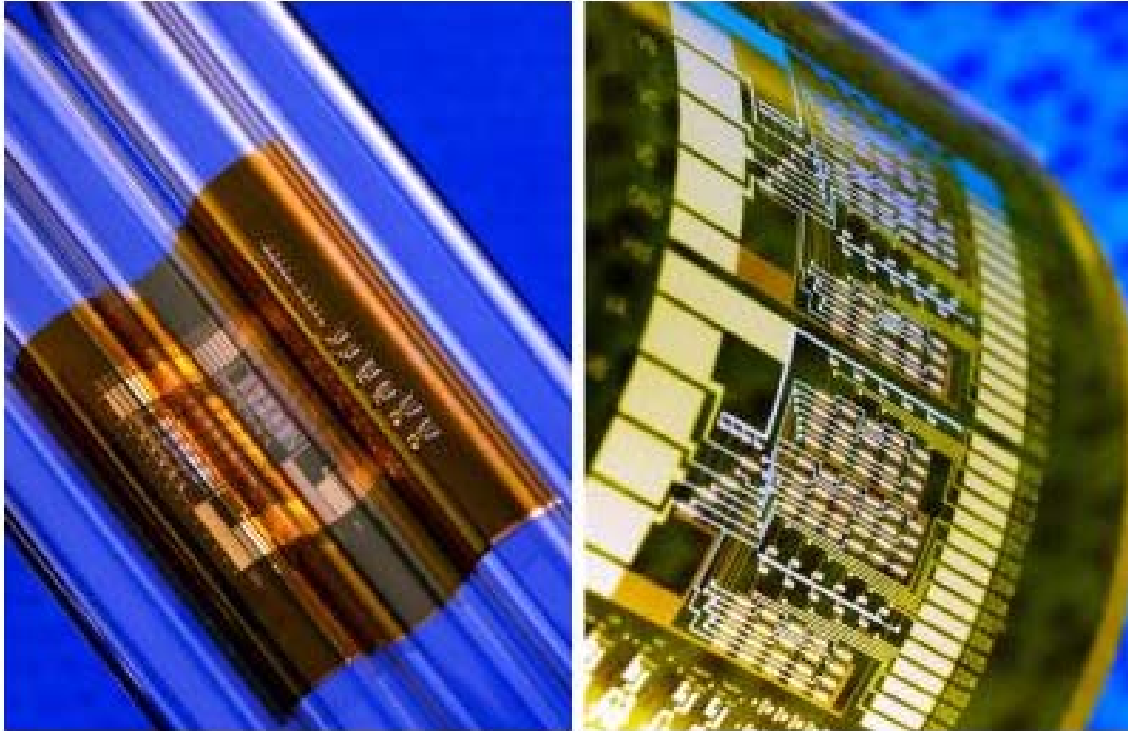
To be practical, however, the photosensors must be integrated with electronics on the same chip. And the materials that make an ideal photosensor are necessarily different from those that make a good transistor.

"Our integration of arrays of nanowires that perform separate functions and are made of heterogeneous substances – and doing this in a way that can be reproduced on a large scale in a controlled way – is a first," says Ali Javey, who led the research team. Javey is a staff scientist in Berkeley Lab's Materials Sciences Division (MSD) and an assistant professor in the Electrical Engineering and Computer Sciences Department at UC Berkeley. He and his colleagues report their work in the August 1 edition of *Proceedings of the National*

Lähitulevaisuus: elektroniikka ja tietokoneet

- Hiilinanoputket: kupariin verrattuna kantavat 1000 kertaa enemmän virtaa, välittävät elektroneita 10 kertaa nopeampaa ja haihduttavat lämpöä tehokkaammin.
- Yhdestä molekyylistä koostuvia transistoreita kehitteillä
- ”Tuhansia kertoja ihmishiusta pienempiä” mekaanisia kytkimiä
- Mooren laki ei näytä olevan kuolemassa
- ”Joustavaa” elektroniikkaa

2 Photos of Flexible Circuits



Caption: These are two photos of flexible circuits created using carbon nanotubes in research at Purdue University and the University of Illinois at Urbana-Champaign. The researchers have overcome a major obstacle in producing transistors from networks of carbon nanotubes, a technology that could make it possible to print circuits on plastic sheets for applications including flexible displays and an electronic skin to cover an entire aircraft to monitor crack formation.

Credit: University of Illinois at Urbana-Champaign

[E-mail this to a friend](#)

[Printable version](#)

Nano switch hints at future chips

By Darren Waters

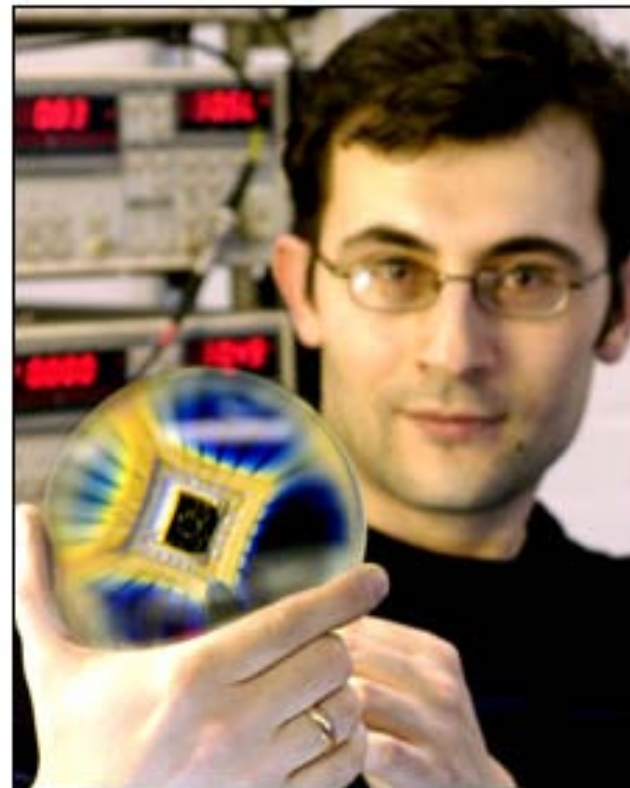
Technology editor, BBC News website

Researchers have built the world's smallest transistor - one atom thick and 10 atoms wide - out of a material that could one day replace silicon.

The transistor, essentially an on/off switch, has been made using graphene, a two-dimensional material first discovered only four years ago.

Graphene is a single layer of graphite, which is found in the humble pencil.

The transistor is the key building block of microchips and the basis for almost all electronics.



Dr Leonid Ponomarenko shows off a device with the transistor embedded

Virus 'hybrids' can act as nanoscale memory devices

16:17 26 June 2007

NewScientist.com news service

Belle Dumé

A new type of memory device has been made by researchers in the US and Italy by attaching individual viruses to tiny specks of semiconducting material called quantum dots. The "hybrid" material could be used to develop biocompatible electronics and offer a cheap and simple way to make high-density memory chips, the researchers say.

Some biological materials react to inorganic molecules and researchers have already exploited this phenomenon to build nanoscale devices that can be used as biosensors (see [Molecular 'switch' connects biology to silicon](#)).

Mihri Ozkan of the University of California at Riverside and colleagues have now gone a step further by making a device that can also store digital information.

"Interactions between organic and inorganic particles are quite fascinating," team leader Ozkan told **New Scientist**. "In our case, finding the memory effect was quite unexpected because each nanoparticle does not have any memory characteristics on its own, but only when connected as a hybrid."



Lähitulevaisuus: lääketiede

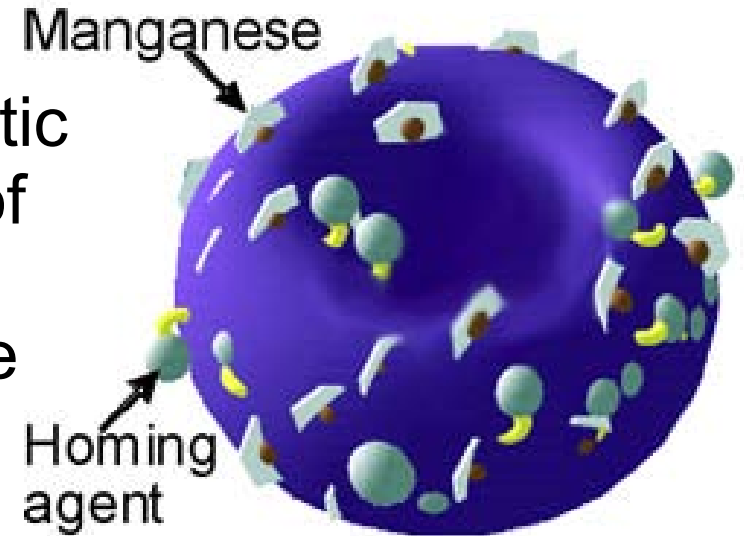
- Yksi luonnollisimpia alueita, ja biologia tarjoaa paljon inspiraation lähteitä (Drexler käytti ribosomia proof-of-conceptina)
- Lääkkeiden kohdistus, puhtaampien ainesosien valmistus
- Nanosensorit helpottavat hoitojen räätälöintiä ja uusien lääkkeiden kehittämistä

Lähitulevaisuus: lääketiede

- Abraxane (2005): rintasyövän hoitoon tarkoitettu ensimmäinen hyväksytty nanoteknologinen lääke
- Sitoo lääkeaineen kehossa luontaisesti esiintyvään vesiliukoiseen proteiiniin - aiemmin ollut tarpeen liuottaa lääke kehoon käyttäen myrkyllisiä ainesosia
- Valmistajan mukaan mahdollistaa 50% suuremman kerta-annostuksen kuin aiempi lääke

Lähtulevaisuus: lääketiede

The bulk of a nanobialy is a synthetic polymer that can accept a variety of medical, imaging or targeting components. In the July 2008 issue of the Journal of the American Chemical Society the researchers report that targeted manganese-carrying nanobialys readily attached themselves to fibrin molecules, which are found in atherosclerotic plaques and blood clots. Laboratory-made clots then glowed brightly in MRI scans. They also showed that the nanobialys could carry both water-soluble and insoluble drugs.



Atlanta (July 16, 2008) —Scientists at Georgia Tech have developed a potential new treatment against cancer that attaches magnetic nanoparticles to cancer cells, allowing them to be captured and carried out of the body. The treatment, which has been tested in the laboratory and will now be looked at in survival studies, is detailed online in the *Journal of the American Chemical Society*.

"We've been able to use magnetic nanoparticles to capture free-floating cancer cells and then take them out of the body," said John McDonald, chair of the School of Biology at Georgia Tech and chief research scientist at the Ovarian Cancer Institute. "This technology may be of special importance in the treatment of ovarian cancer where the malignancy is typically spread by free-floating cancer cells released from the primary tumor into the abdominal cavity."



Magnetic Nanoparticles Capture Ovarian
Cancer Cells

[FLV = 1.77 MB](#)

Lähitulevaisuus: energia

- Hiilinanoputkia käytetty tehokkaampien aurinkopaneelien tekoon ("yli sata kertaa tehokkaampi")
- Polttoainekennot, akut ja paristot - energian varastointi ylipäättään
- Suprajohtavia materiaaleja, sähkönkuljetus
- Kevyempiä ja kestävämpiä materiaaleja, vähentämään esim. polttoaineen kulutusta

'Small' research at MSU leads to advances in energy, electronics

Contact: Lawrence Drzal, College of Engineering, drzal@egr.msu.edu; Russ White, University Relations, Office: (517) 432-0923, russ.white@ur.msu.edu

[E-mail Editor](#)

Published: July 31, 2008

Story

Video

Audio

A Michigan State University researcher and his students have developed a nanomaterial that makes plastic stiffer, lighter and stronger and could result in more fuel-efficient airplanes and cars as well as more durable medical and sports equipment.

The material – xGnP Exfoliated Graphite NanoPlatelets – will be instrumental in the development of new and expanded applications in the aerospace, automotive and packaging industries, said Lawrence Drzal, University Distinguished Professor of chemical engineering and materials science at MSU and director of MSU's Composite Materials and Structure Center.

Drzal led the research group that developed the product, which is considered to be a practical, inexpensive material that has a unique set of physical, chemical and morphological attributes. The nanoscale material, which is electrically and thermally conductive, has reduced flammability and barrier properties, he said.



Nanotubes bring artificial photosynthesis a step nearer

10:20 11 July 2008

NewScientist.com news service

Colin Barras

Carbon nanotubes are the crucial chemical ingredient that could make artificial photosynthesis possible, say a team of Chinese researchers. The team has found that nanotubes mimic an important step in photosynthesis that chemists have been unable to copy until now.

Artificial photosynthesis has the potential to efficiently produce hydrogen that could be used as a clean fuel for vehicles. It could also be used to mop up carbon dioxide from the atmosphere.

Photosynthetic organisms use the energy from light to break down water into oxygen and hydrogen. The hydrogen then reacts with carbon dioxide to help synthesise carbohydrates, the molecules organisms use to store energy.

Chemists have long tried in vain to reproduce the process, but one key step in particular has proven impossible to copy.

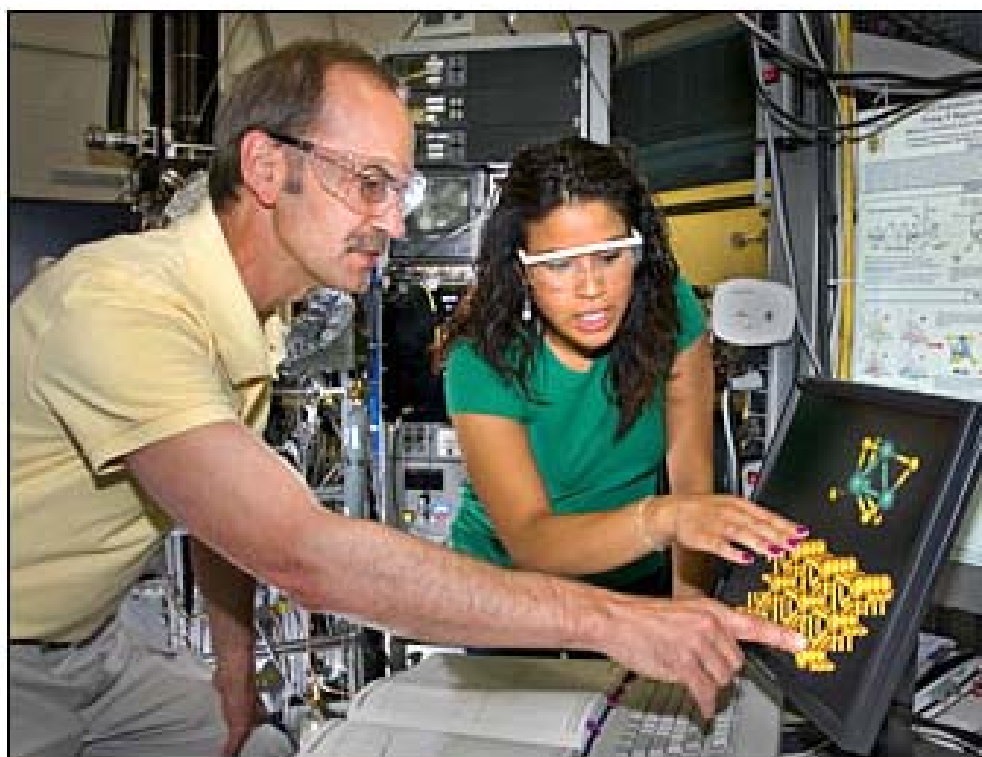
Controlling the Size of Nanoclusters: First Step in Making New Catalysts

July 9, 2008

UPTON, NY -- Researchers from the U.S. Department of Energy's (DOE) Brookhaven National Laboratory and Stony Brook University have developed a new instrument that allows them to control the size of nanoclusters — groups of 10 to 100 atoms — with atomic precision. They created a model nanocatalyst of molybdenum sulfide, the first step in developing the next generation of materials to be used in hydrodesulfurization, a process that removes sulfur from natural gas and petroleum products to reduce pollution.

As reported in the July 9, 2008 online edition of the *Journal of Physical Chemistry C*, the scientists made size-selected molybdenum sulfide nanoclusters as gaseous ions, and then gently deposited the clusters on a gold surface. The nanoclusters interact weakly with the gold support and therefore remain intact.

"With this new instrument, we can control how many and what type of atoms are in a nanocluster," said Brookhaven chemist Michael White, the principal author of the paper. "This knowledge enables us to make nanoclusters with predetermined size, structure and chemical composition, all which are important for the design of new catalysts."



Michael White and Melissa Patterson review an image of a molybdenum sulfide nanocluster. (Click image to download hi-res version.)

"This knowledge enables us to make nanoclusters with predetermined size, structure and chemical composition, all which are important for the design of new catalysts."

'Major discovery' from MIT primed to unleash solar revolution

Scientists mimic essence of plants' energy storage system

Anne Trafton, News Office

July 31, 2008

In a revolutionary leap that could transform solar power from a marginal, boutique alternative into a mainstream energy source, MIT researchers have overcome a major barrier to large-scale solar power: storing energy for use when the sun doesn't shine.



Drextech

Eli mitenkäs se harmaa mönjä?

Drextech

Eli mitenkäs se harmaa mönjä?

- Drexler itse sanotunut irti itseäänmonistavan nanobotin ajatuksesta (tästä enemmän grey goon kohdalla)
- Nanotehtailla nanobotteja!

H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	Lu	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Lr	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg							
		La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb		
		Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No		

Drextech & lääketiede

- Robert Freitas: Hivenen spekulatiivisemmalla puolella... toistaiseksi
- Respirosyytit: keinotekoiset verisolut - 236 kertaa enemmän happea, nanotietokone annostelee muiden aineiden erityystä
- Chromallosyytit: robotteja jotka vaihtavat soluytimien kromosomeja uusiin (geenimanipulointi)
- Mikrobiovoret: keinotekoisia immuunijärjestelmän lisäkomponentteja

**Table 6. Microbivore Processing Timeline for a Single
0.4 micron × 2 micron *Pseudomonas aeruginosa* Bacterium**

Completion of Event:	Time Required to Complete	Elapsed Time (millisec)
Microbe Approaches the Nanorobot	----	0
Microbial Recognition and Binding	0.030 msec	0.03
Extend Grapples	0.25 msec	0.28
Microbial Debinding from Receptors	0.100 msec	0.38
Transport Microbe to Ingestion Port	3 msec	3.38
Open Ingestion Port Door	0.1 msec	3.48
Microbe Internalization into MC	1000 msec	1,003.48
Close Ingestion Port Door	0.1 msec	1,003.58
Mince the Microbe in MC	400 msec	1,403.58
Open MC/DC Interchamber Door	0.1 msec	1,403.68
Activate MC Ejection piston	100 msec	1,503.68
Close MC/DC Interchamber Door	0.1 msec	1,503.78
Digest Microbe in DC: Enzyme Injection Enzyme Digestion Enzyme Extraction subtotal × 240 sub-subcycles (ssc)	1 msec/ssc 50 msec/ssc 50 msec/ssc <hr/> 101 msec/ssc = 24,240 msec	25,743.78
Open Annular DC Exhaust Port Door	0.1 msec	25,743.88
Activate DC Ejection piston	10 msec	25,753.88
Close Annular DC Exhaust Port Door	0.1 msec	25,753.98

Kurzweil et al.: sulautuminen

Rajat häilyvät jo 2012

Intelin tutkija: ihmis- ja tietokoneäly yhdistyvät 40 vuodessa

26.7. klo 09:39 Intelin CTO Justin Rattner arvelee tietokoneiden elävän yhteistyössä ihmisten kanssa vuoteen 2050 mennessä.

Vuonna 2050 vuoden päästä ihmisen ja koneen raja ovat monin tavoin nykyistä häilyväisempiä, ennustaa Intelin chief technical officer **Justin Rattner** [Computerworldin haastattelussa](#).

Ensimmäiset muutokset alkavat jo muutaman vuoden päästä, kun nanokoneet ja älykkäät agentit alkavat toimia oma-aloitteisesti eivätkä pelkästään ihmisten ohjastamina. Virtuaalimaailmoiden ja ubiikkitietokoneiden myötä sekä ihmisaistit että -ajatukset ovat tietokoneiden laajentamia, ja roboteista kehittyy älykkäitä ja tuntevia seuralaisia.



Kuva: Jan Schulte-Tigges /
Lehtikuva

Drextech

Eli mitenkäs se harmaa mönjä?

- Tiedeyhteisö välttänyt suurempaa keskustelua Drexlerin visiosta - niin positiivista kuin negatiivistakin
- Drexler vs. Smalley, 2001-2003
- IEEE Spectrum, 2008: Richard Jones - Rupturing the Nanotech Rapture

Hiljaisuus varovainen strategia?

- Richard Smalley: "You and people around you have scared our children. I don't expect you to stop, but I hope others in the chemical community will join me in turning on the light, and showing our children that, while our future in the real world will be challenging and there are real risks, there will be no such monster as the self-replicating nanobot of your dreams."

Hiljaisuus varovainen strategia?

- Lawrence Lessig: "As the editors of *Chemical & Engineering News* put it, Smalley's 'objections go beyond the scientific'. They are a strategy - if so-called serious nanotech can be relegated to summer sci-fi movies and forgotten after Labor Day, then serious work can continue, supported by billion-dollar funding and uninhibited by the idiocy that buries, for example, stem cell research."

Hiljaisuus varovainen strategia?

- Richard Jones: "But in academia and industry, nanotechnologists are working on a very different set of technologies. Many of these projects will almost certainly prove to be useful, lucrative, or even transformative, but none of them are likely to bring about the transhumanist rapture foreseen by singularitarians. *Not in the next century, anyway.*"

Drextech - todennäköisyys?

- Nanoteknologian toimivuus biologisessa ympäristössä ja biologisena koneena on varma (ribosomit)
- Solukoneet toimivat kuitenkin hyvin eri tavalla kuin perinteiset koneet: mahdollisia rajoituksia esim. toimintaympäristössä
- Mekanosynteesin toimivuus vielä ?
- Tutkimusta kuitenkin tapahtuu

Is mechanosynthesis feasible? The debate moves up a gear.

Followers of the Drexlerian flavour of radical nanotechnology often accuse nanoscientists of ignoring their approach for reasons of politics or prejudice, and take the lack of detailed critiques of books like *Nanosystems* as evidence that the whole Drexlerian program is feasible, and indeed imminent. Scientists, on the hand, find the Drexlerian proposals too futuristic and too lacking in practical implementation details to be even worth criticising. The result is an ever-widening gulf between the increasingly bitter Drexlerites and a dismissive and contemptuous mainstream nanoscience community, which does neither side any good. So it's a very positive development that [Robert Freitas](#) has presented a [detailed scheme](#) for achieving the first steps towards the mechanosynthesis of diamondoid nanostructures, and even more positive that [Philip Moriarty](#) has made a detailed critique of these proposals, based on his deep practical knowledge of scanning tunneling microscopy and surface growth processes.

Tutkimusta on meneillään...

EurekAlert 28.4.2008:

The first real steps towards building a microscopic device that can construct nano machines have been taken by US researchers. Writing in the peer-reviewed publication, International Journal of Nanomanufacturing from Inderscience Publishers, researchers describe an early prototype for a nanoassembler.

...

"Our micro-scale nanoassembly system is designed for real-time imaging of the nanomanipulation procedures using a scanning electron microscope," explains Gorman, "and multiple nanoprobes can be used to grasp nanostructures in a cooperative manner to enable complex assembly operations." Importantly, once the team has optimized their design they anticipate that nanoassembly systems could be made for around \$400 per chip at present costs. This is thousands of times cheaper than macro-scale systems such as the AFM.

Nanoscale freighter hauls its first load

19:00 10 April 2008

NewScientist.com news service

David Robson

A nanoscale "monorail" that can creep along a nanotube track has shifted its first load, hauling a gold nugget a distance of 0.5 micrometres. The device could be a useful addition to microscopic construction toolkits that researchers hope will advance computing and other fields.

The new device developed by researchers in Spain, Austria and Switzerland is made from two nanotubes nested like the parts of a telescope.

The central tube is one micrometer long and acts as a rail for the second, smaller, 200-nanometre nanotube. The outer "monorail carriage" is driven by applying current to the inner rail, and can move in both directions along the rail – it can also rotate around it.

In trials, the device was used to transport a ball of gold about 250 nanometres wide along the track for a distance of 500 nanometres (0.5 micrometres). It moves at speeds ranging from 0.1 nanometres per second to 1 micrometre per second. The researchers observed the motion using an atomic force microscope.

Range of movement

"It is the first nano-freighter train," says Andrea Ferrari, an expert in



PRINT



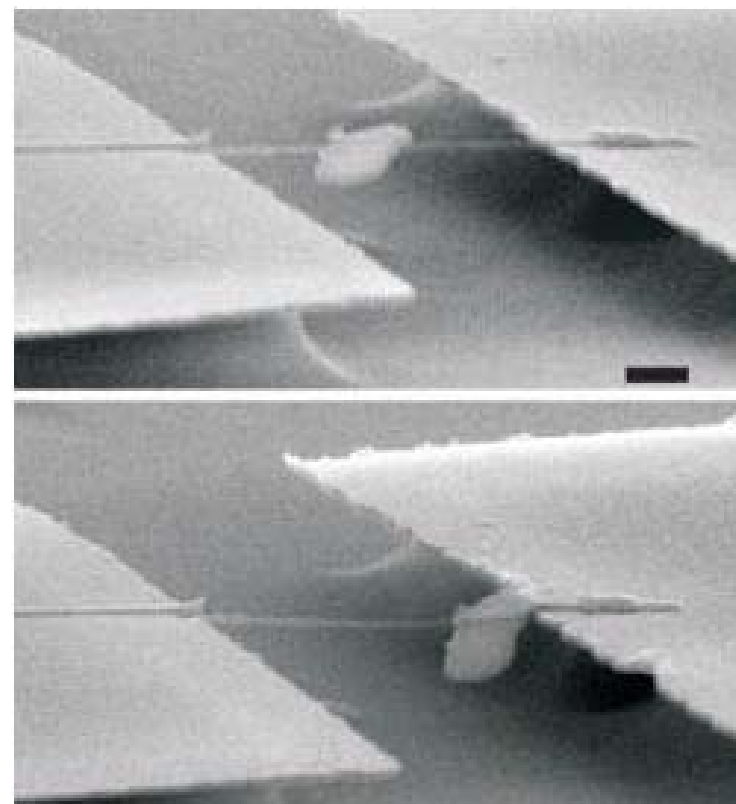
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FEEDS



SYNDICATE



[Enlarge image](#)

A nanoscale "monorail" shifts cargo along a track made from a single nanotube, scale bar 300 nm (Image: Science)

Mitä jos se toteutuu?

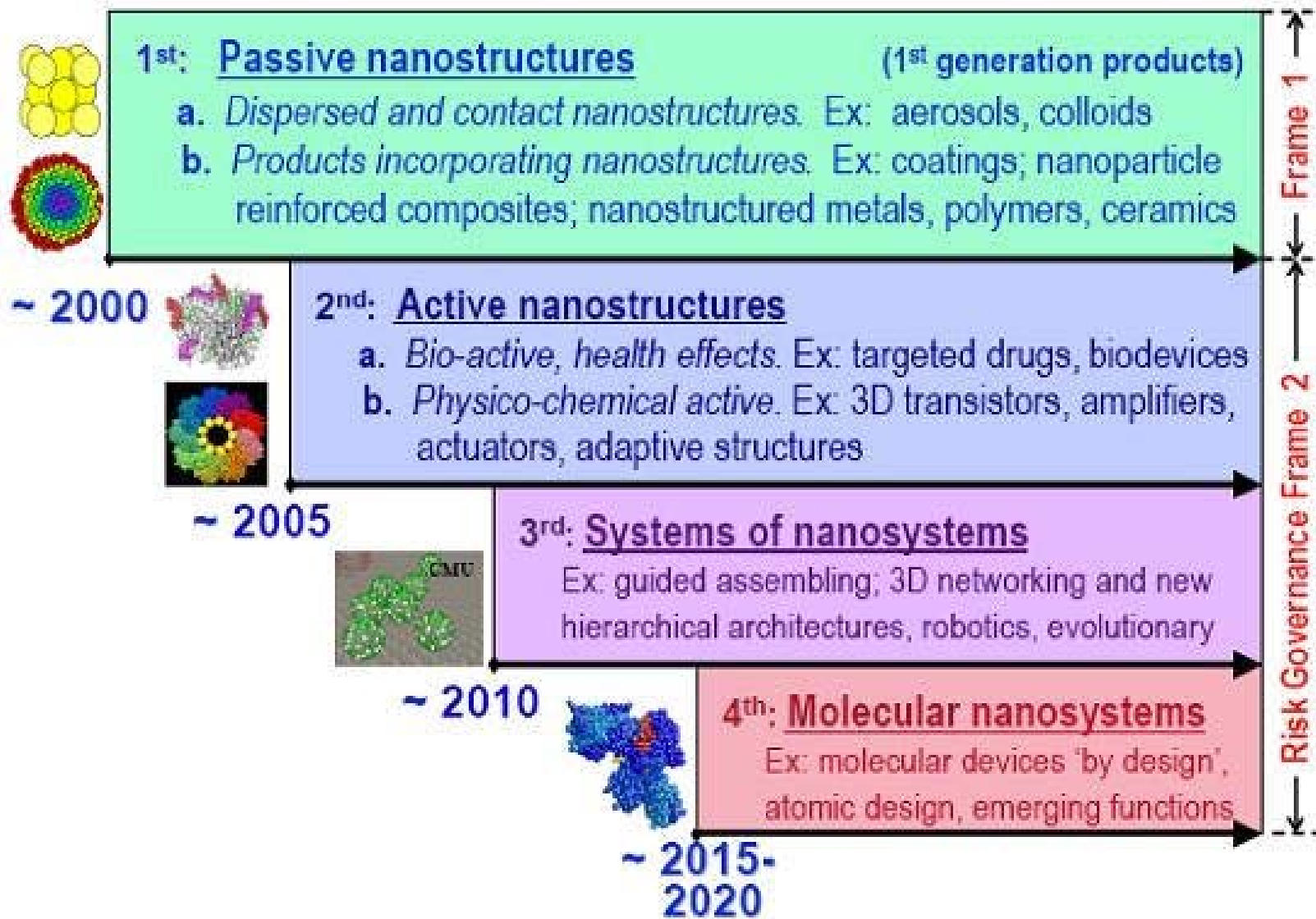
The first step in understanding the dangers is to identify them. CRN has begun that process here, listing and describing several separate and severe risks. Although probably incomplete, the list is worrisome already:

CRN has identified several separate and severe risks.

- [Economic disruption from an abundance of cheap products](#)
- [Economic oppression from artificially inflated prices](#)
- [Personal risk from criminal or terrorist use](#)
- [Personal or social risk from abusive restrictions](#)
- [Social disruption from new products/lifestyles](#)
- [Unstable arms race](#)
- [Environmental damage or health risks from unregulated products](#)
- [Free-range self-replicators \(grey goo\)](#)
- [Black market in nanotech \(increases other risks\)](#)
- [Competing nanotech programs \(increases other risks\)](#)
- [Attempted relinquishment \(increases other risks\)](#)

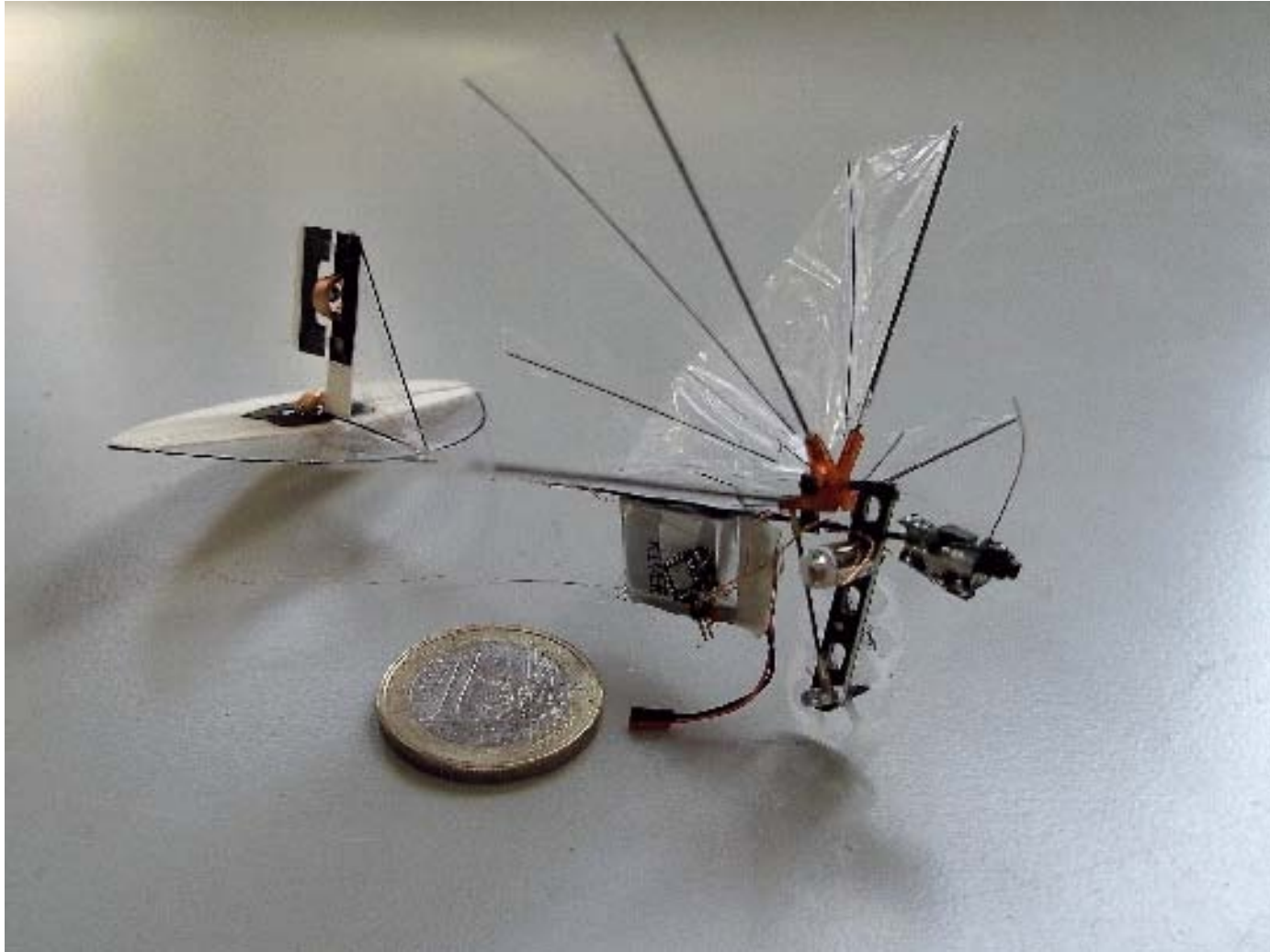
Some of the dangers described here are *existential risks*, that is, they may threaten the continued existence of humankind. Others could produce significant disruption but not cause our extinction. A combination of several risks could exacerbate the seriousness of each; any solution must take into account its effect on other risks.

Milloin se toteutuu?



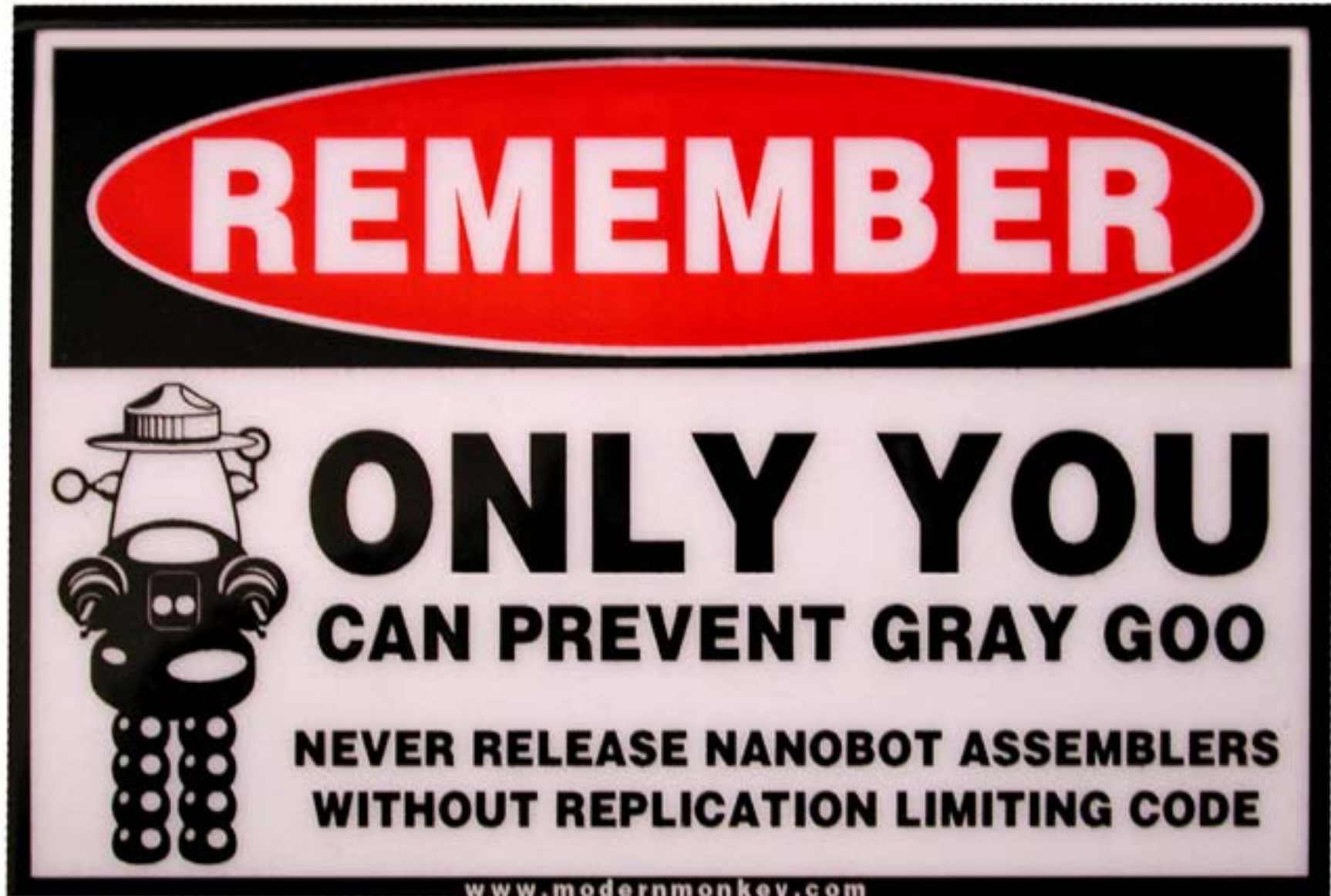
(Center for Responsible Nanotechnology)

Iso juttu: yksityisyys




(22.7.2008)

No entäs se harmaa mönjä?



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**NEVER RELEASE NANOBOT ASSEMBLERS
WITHOUT REPLICATION LIMITING CODE**

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Grrrreeeyy ggggooooooo

- Itsereplikoituvuus turhaa liikkuvissa nanokoneissa: nanotehdastyypiset ratkaisut turvallisempia
- Harmaata mönjää tuskin vahingossa syntyy: terroristien suunnitelmat ovat eri asia
- Foresight Instituten suosittelee mm. itsemonistuvien bottien piirrustusten kryptaamista

Grrrreeeyyy ggggooooo

- Freitas (2001): ...ecophagy that proceeds slowly enough to add $\sim 4^{\circ}\text{C}$ to global warming (near the current threshold for immediate climatological detection) will require ~ 20 months to run to completion; faster ecophagic devices run hotter, allowing quicker detection by policing authorities.
- The smallest plausible biovorous nanoreplicator has a molecular weight of ~ 1 gigadalton and a minimum replication time of perhaps ~ 100 seconds, in theory permitting global ecophagy to be completed in as few as $\sim 10^4$ seconds. However, such rapid replication creates an immediately detectable thermal signature, enabling effective defensive policing instrumentalities to be promptly deployed before significant damage to the ecology can occur...