

# Klein, Kleiner, Kleinst

M. Van Rossum  
Imec en KULeuven

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# Nanotechnologie...

## Hoe klein?

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Vergelijking van afmetingen van enkele objecten

diameter speldenknop	1 millimeter, of 1 miljoen nanometer
diameter menselijke haar	80 micrometer, of 80.000 nanometer
lengte staart menselijke spermaceel	50 micrometer
diameter menselijke eicel	20 micrometer
dikte aluminium huishoudfolie	10 micrometer
diameter bacterie	2 micrometer
dikte wand van een zeepbel	750 nanometer
lengte virus	100 nanometer
dikte DNA-molecuul	2 nanometer
diameter waterstofaatom	0,1 nanometer

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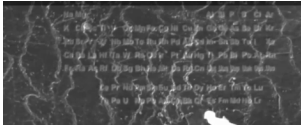
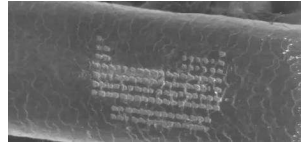
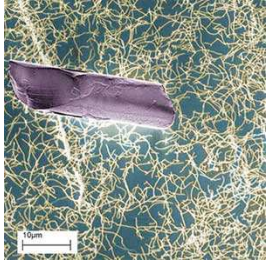
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## De nanoschaal: een haartje



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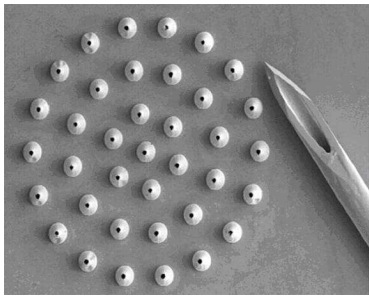
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## Nanonaalden



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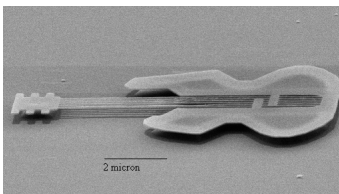
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## Nanogitaar



Bron : Cornell University

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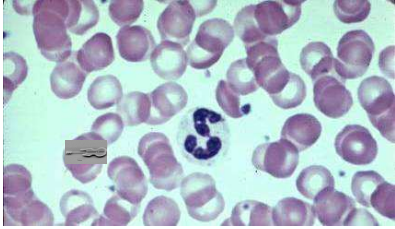
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## Rode bloedcellen



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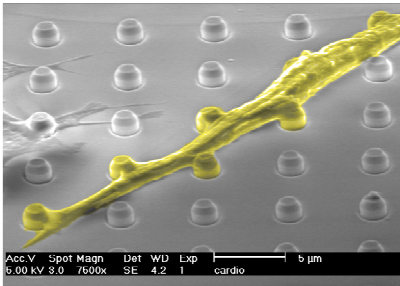
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## Neuronen op chip



Bron : IMEC / U. Jeruzalem

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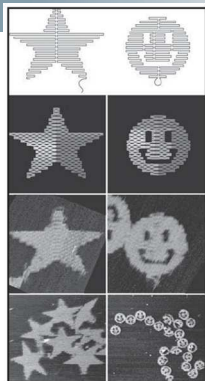
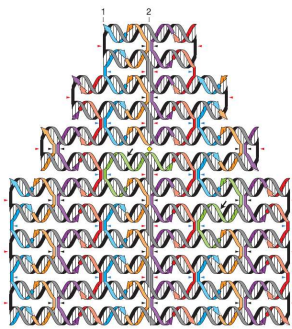
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## DNA Origami



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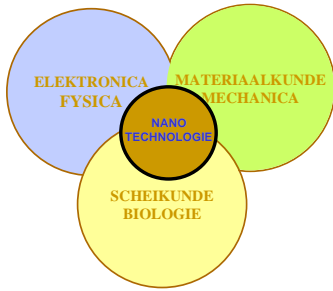
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## Nanotechnologie is multidisciplinair !



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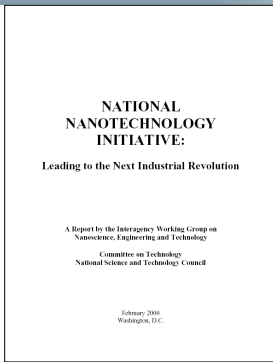
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## Nanotechnologie: Made in USA?



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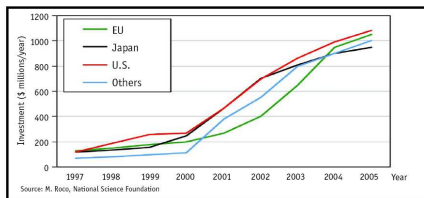
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## Investeren in nanotechnologie O&O



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# Wat zijn de bouwblokken?

**nanochips**  
**nanobuisjes**  
**nanokorrels**

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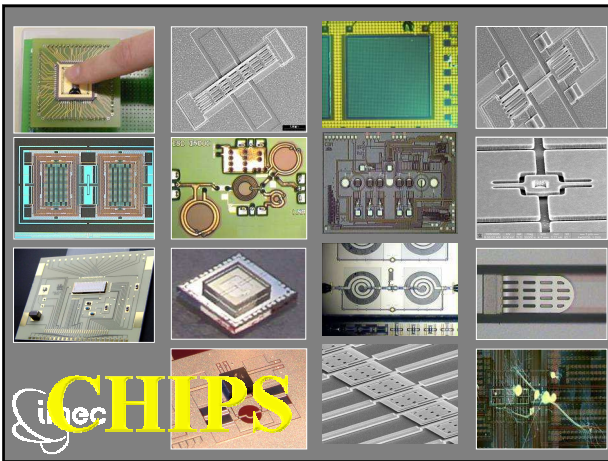
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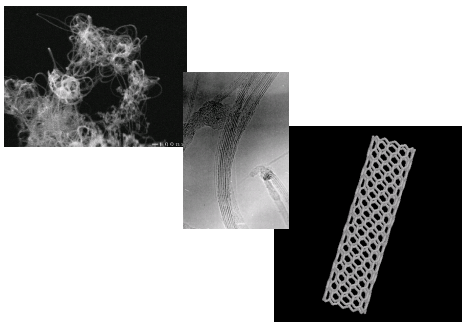
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## Koolstof nanobuisjes



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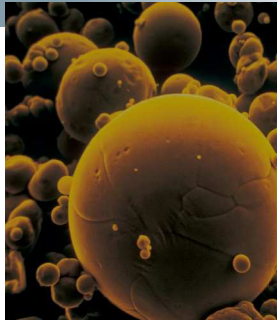
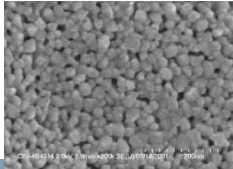
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## Nanokorrels



Titaan oxide

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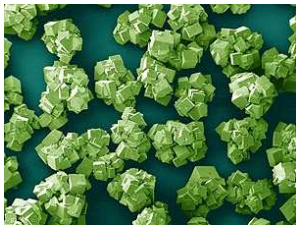
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## Nanokubusjes



Poreuze kubusjes voor waterstofopslag (BASF)

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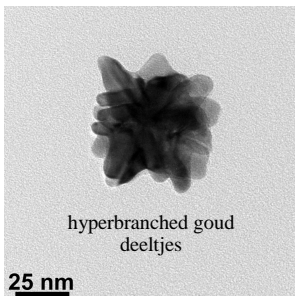
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## Nanodeeltjes voor kankerbestrijding



hyperbranched goud deeltjes

25 nm

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# Nanotechnologie...

## Ook voor politietaken?

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- Protectie
- Detectie
- Bewaking
- Transmissie

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### Nanodeeltjes in suspensie



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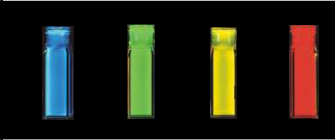
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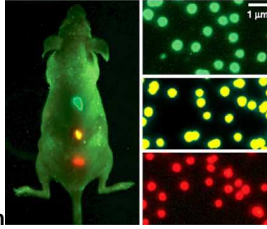
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## Beeldvorming met nanodeeltjes

### nanodeeltjes



2.3 nm   4.2 nm   4.8 nm   5.5 nm



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## Detectie vingerafdrukken met nanodeeltjes

A major breakthrough in fingerprint testing may reopen previously closed police investigations by employing new nanotechnology techniques.



Described as revolutionary by people who are not prone to exaggeration (the United States Secret Service), the new nanotechnologies will enable fingerprints to be clearly developed that current techniques cannot detect.

The current method for revealing prints involves coating surfaces with a watery suspension of gold nanoparticles and citrate ions. Under acid conditions, the gold particles stick to the positively charged particles in the print.

Criminals Beware!

It appears that criminals who believe they have got away with it through lack of fingerprint evidence may in fact be in for a shock.

In a remarkable breakthrough, Australian researchers have managed to recover usable fingerprints from evidence decades old.

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## Protectie: Carbon nanotubes (CNT)

Diameter : >1 nm



100 x sterker dan staal !



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September 18, 2009

### Nanotechnology being tested for next-gen body armor

A Concord, New Hampshire-based start-up called Nanocomp Technologies has been testing carbon nanotubes — a material allegedly lighter than plastic but “100 times stronger than steel” — for use in body armor designs of the future. The company says that its carbon nanotubes will help it accomplish its goal to “create products with revolutionary performance benefits.”

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# Wat zijn de bouwblokken? nano-netwerken

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## Body area networks



Necklaces/patches

Watch-type

Headsets

Base Stations



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Zio by iRhythm      Piix by Corventis      Digital plaster by Toumaz

**NEEDED:**  
Flexible, Stretchable, Ultrathin 'Patches'

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## Energie captatie

Photovoltaic	Vibration	Thermal	RF
<ul style="list-style-type: none"> <li>Outdoor: 10 mW/cm<sup>2</sup></li> <li>Indoor: 10 μW/cm<sup>2</sup></li> </ul>	<ul style="list-style-type: none"> <li>Man: 4 μW/cm<sup>2</sup></li> <li>Machine: 100 μW/cm<sup>2</sup></li> </ul>	<ul style="list-style-type: none"> <li>Man: 20 μW/cm<sup>2</sup></li> <li>Machine: 1-10 mW/cm<sup>2</sup></li> </ul>	<ul style="list-style-type: none"> <li>GSM: 0.1 μW/cm<sup>2</sup></li> <li>WiFi: 0.01 μW/cm<sup>2</sup></li> </ul>

\*Vulliers et al., Micropower Energy Harvesting, Solid-State Electronics 53 (7) Pgs 684-693, DOI: 10.1016/j.sse.2008.12.011

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## INTEGRATED SECURITY

Aerial imaging      Security Compute Server      CCTV systems

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## UAVs

The U.S. military's development of the UAV would significantly affect law enforcement. Using existing nanotechnology, police UAVs would be the size of a small bird and stay aloft quietly for hours. Using facial and voice recognition software, the devices would scan hundreds of yards omnidirectionally, day or night, for felons or wanted persons. One UAV could perform many of the same tasks as several officers in unmarked vehicles.



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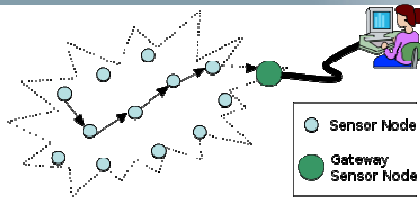
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## Detectie: Draadloze sensornetwerken



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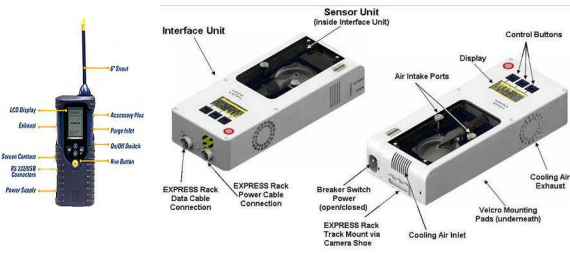
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## E-nose



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### e-Neus Scenarios in Body Area Networks

Air quality monitoring and indoor air quality control (pollution, malodor emission, toxic gases...)

Ripeness, Food contamination (spoilage, shelf life...)

Consumer fraud prevention (ingredient confirmation, content standards...)

Taste, smell characteristics (off flavors, product variety assessment...)

Pathogen identification (patient treatment selection, prognosis...)

Personnel and population security (biological and chemical weapons...)

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### Medische beeldverwerking

MRI

Ultrasound

PET / CT / OCT

Hyperspectral Imaging 3D/4D imagers

Digital X-ray

Vein viewer

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### Opsporing van drugs

Smuggler Arrested With 72 Cocaine Capsules in Stomach (X-RAY PHOTO)

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## Echografie



2D image with 1D array



3D image with 2D array



4D image with 2D array

source: VTT

IMEC 2011 - CONFIDENTIAL

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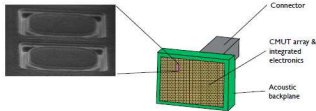
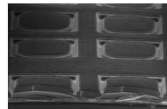
## Draagbare echografie

User-friendly & operator independent

Hospital-grade equipment order of magnitude cost reduction

Durable

Remote care



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# Waar zijn de nanoprodukten?

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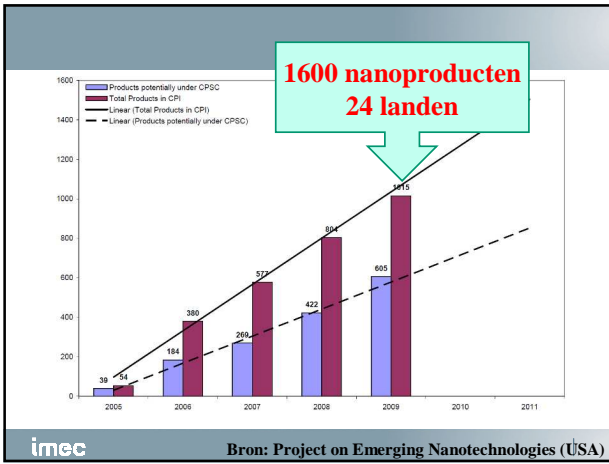
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**Men's nano-dry shirts**  
**Jack Wolfskin (Duitsland)**



**Nano-Care® Stressfree Khakis**  
**Gap (USA)**



**Nano rain hat**  
**Pro-Idee GmbH (Duitsland)**




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**Zinclear nano-zinc oxide zonnecreme**  
**Advanced Nanotechnology Limited (Australië)**



**Awake Nano Lotion White**  
**Kose Corporation (Japan)**



**Gold Nanoparticle soaps**  
**Quan Zhou Hu Zheng Nano Technology Co (China)**




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**Nano-tex nanosilver socks**  
**Lexon Nanotech (USA)**



**Nanbabies Personal wear**  
**Nanbabies (USA)**



**SAMSUNG Silver Nano Mobile Phone**  
**SAMSUNG (KOREA)**



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**Nano TiO2 - UV Air Purifier**  
**Kind Home (Taiwan)**



**Daewoo Nanosilver refrigerator**  
**Daewoo (Korea)**



**Nano-silver Washing machine-sterilisator**  
**Samsung (Korea)**



**Regulering ?**

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**Nano-protex Textile anti-dirt**  
**Nanotec Pty Ltd (Australië)**



**Deletum 3000 Nano-silica Anti-graffiti paint**  
**Victor Castagno (Mexico)**



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**15 Global Challenges**  
facing humanity

**NANO?**

by the Millennium Project of WFUNA  
www.millennium-project.org

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**Nanotechnologie...**

**Is het gevaarlijk?**

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**“Asbest effect”**

**Penetratie van nanodeeltjes**

**Hersenen**

**Lungen**

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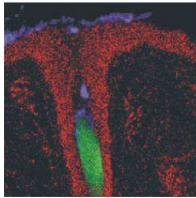
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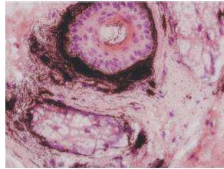


## Huidpenetratie

### nanodeeltjes



Porcine skin



Hair follicle (human)

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## Besluit: Tussen hoop en vrees

### Maatschappelijke kwesties, droom- en schrikbeelden rondom nanotechnologie

Toepassingsgebied	Maatschappelijke kwesties	Droombeelden	Schrikbeelden
nanomaterialen / industriële productie	gezondheids- en milieueffecten zelf(re)productie	duurzaamheid universal assembler personal fabrication	nano-asbest grey goo
nano-elektronica	privacy	slimme producten en omgeving	big brother
bio-elektronica	maakbare mens mengvormen van leven en niet-leven	wereld zonder handicaps koppeling internet	discriminatie van 'handicaps' dehumanisering vervreemding
nanotechnologie in de medische sfeer	voorspellende geneeskunde	vroege diagnostiek medicijnen op maat	dwang / uitsluiting tweedeling in de zorg

Bron: Rathenau instituut

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