

COMMERCIAL APPLICATIONS OF NANOTECHNOLOGY

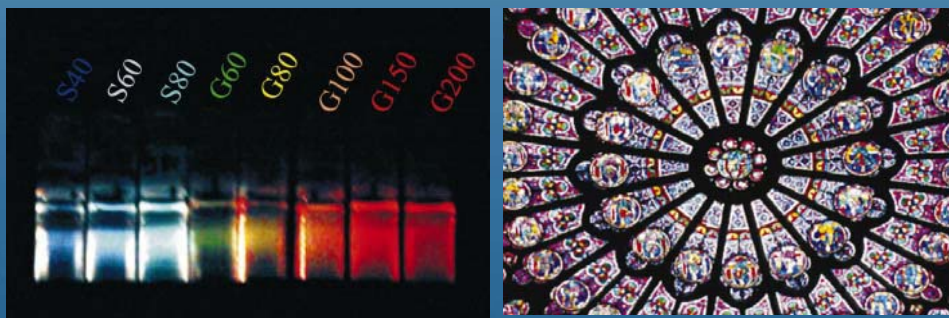
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ITEMS TO BE DISCUSSED

- Current nanotechnology applications
- Future application in the world
- In Finland
- In Oulu area

THE MOST FAMOUS NANOTECHNOLOGY APPLICATIONS

The yellow- and red-colored stained glass on the rose window of Notre Dame Cathedral is made up of nanometer-size particles of silver and gold.



Dependence of colours obtained on particle size and the rose window at Notre Dame Cathedral, Paris. *Haes et al., J. Fluorescence, July 2004.*

MODERN APPLICATIONS: sensors, biological labels, OLEDs...

Evident Technologies, USA, produces commercial Quantum Dots with size < 10 nm for e.g. lightning, solar cell and biological markers applications
<http://www.evidenttech.com/>

OTHER COMMERCIAL APPLICATIONS TODAY



Mercedes M-class
scratch-proof paint, **nanoparticles** in
paint harden in paintshop oven

A three-fold improvement in scratch
resistance

Wilson's and Bobolat's better tennis rackets
with **carbon nano tubes** and **strategic
location of nano size silicon particles**

10 time stiffer and extremely durable rackets



OTHER COMMERCIAL APPLICATIONS TODAY



Lotus Effect[®] water-repellent **self-cleaning shirts** - water repellent surface, dirt particles can hardly get a hold and can thus be removed by a rinse

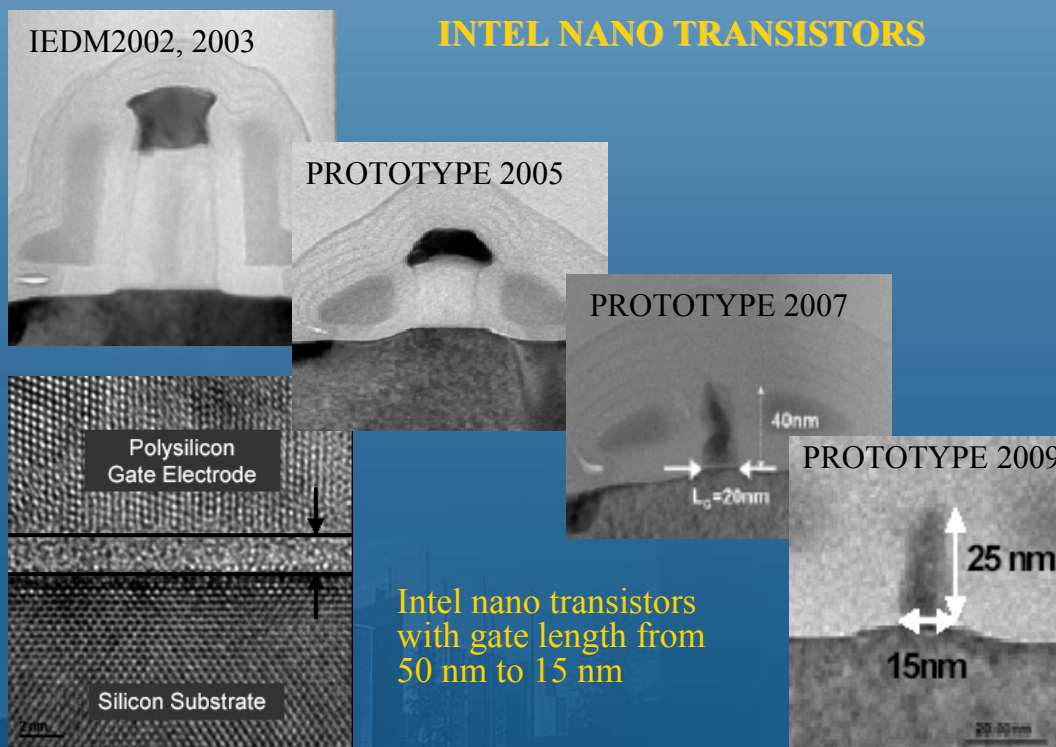
(summer 2005, also glass, spray, paint)

L'Oreal Cosmetics' Plenitude line contains **nanocapsulates** which active ingredients get to the skin's deeper layer

(130-600 nm, tiny polymeric shell capable of guiding the active ingredients to the right place in the skin.)



INTEL NANO TRANSISTORS



Intel nano transistors with gate length from 50 nm to 15 nm

SiO₂ gate oxide with 1.2 nm thickness (Intel)

C. Block, *Extending Moore's Law with Nanotechnology*, Intel Co., IR-TR-2003-5-CarolynBlock091803.pdf

OTHER COMMERCIAL APPLICATIONS TODAY

ON THE MARKET

- lasers modulators for telecommunication
- computer peripherals (e.g. VCSEL = *Vertical Cavity Surface Emitting Laser*)
- sunscreens with nanoparticles
- nanocatalysts
- "lab-on-chip" diagnostics, biomaterials
- electronic displays ("intelligent ink on paper")

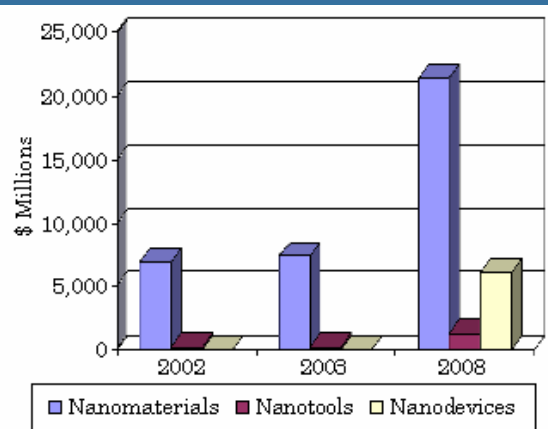
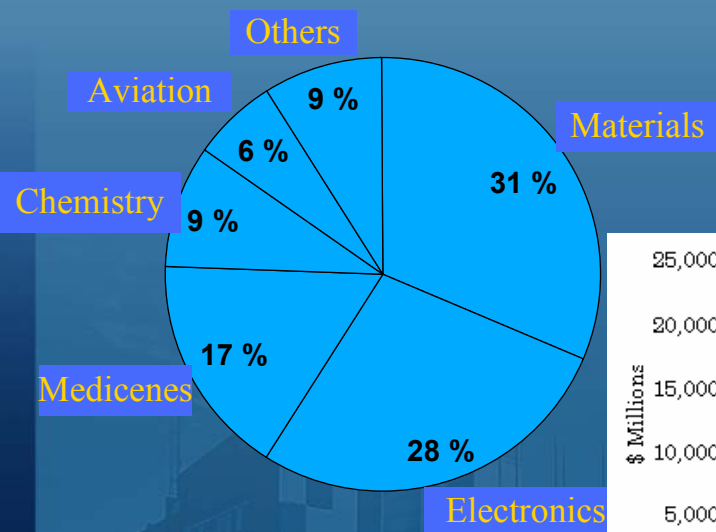
COMING SOON

- friction resistant surfaces
- harder –lighter – stronger materials
- electronics components (smaller and more powerful memory devices)
- ceramic membranes (filters)
- fuel additives
- paper-like displays, flexible circuitry and flexible solar cells
- light, flexible, wearable electronics

GLOBAL NANOTECHNOLOGY MARKET, 2002-2008

YEAR 2015

Scenario from 0,5 billion US\$ to 2,0 billion US\$



FACTS OF FINNISH NANOTECHNOLOGY



TEKES



FinNano

- The first Finnish nanotechnology programme **NANO** (1997-1999).
- The number of nanotechnology **publications** has increased steadily. Finland is the 26th in international comparison.¹
- Finnish nanotechnology **patents** are still few.²
- Several recognized nanotechnology **competence networks** exist.
- Between 300 and **500 people** work actively with nanotechnology.
- The first call of FinNano resulted **102 pre-proposals**, total costs of over 91 M€.

NANOTECHNOLOGY IN TEKES (12.10.2005)

- Projects contain nanotechnology
- All together 50 projects
 - approx. 20 company projects
 - approx. 30 research projects
 - 9 proposals

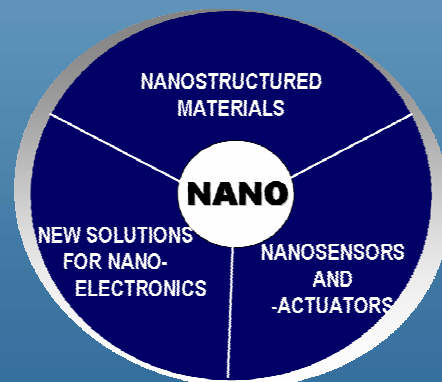
1. Third European Report on Science & Technology Indicators, EC (2003)

2. Tekes & VTT (2004)

TEKES FinNano –PROGRAMME

Focus on

- Innovative nanostructured materials
- New solutions for nanoelectronics
- Nanosensors and nanoactuators



TEKES



FinNano



PARTICIPATING COMPANIES IN FINNANO



Infotech "Day of Science" in Oulu, 11th of Nov., 2005



NANOSCIENCE RESEARCH PROGRAMME OF THE ACADEMY OF FINLAND

- The aim of the research programme is to increase nano-research networking nationally and internationally, and to prepare for future requirements of infrastructure and experts
- Interdisciplinary nature of research is seen essential
- **Preliminary thematic areas are:**
 - **Directed Self-Assembly**
 - **Functionality in Nanoscale**
 - **Properties of Single Nanoscale Objects**
- The proposed duration is four years (2006-2009)
- Proposed volume is 10 million euros
- **Programme Call is expected in November with DL in January 2006**

NANOTECHNOLOGY RESEARCH IN THE UNIVERSITY OF OULU



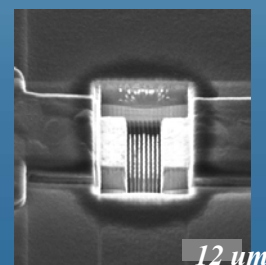
International cooperation within research projects:

- Université de Technologie de Compiègne, France
- Cranfield University, UK
- National Institute of Advanced Industrial Science and Technology (AIST), Japan
- Massachusetts Institute of Technology (MIT), Electro-ceramics group, USA
- University of Surrey, Advanced Technology Institute, UK
- University of Arizona, Optical Sciences Center, USA
- Moscow State University, Russia
- Humboldt University Berlin, Germany
- Over 20 partner in Europe in NoE (University of Lancaster, Fraunhofer IMS, Tyndall National Institute,...)

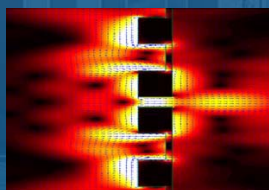
Over 20 industrial partners!

APPLICATIONS OF ONGOING NANO PROJECTS IN THE UNIVERSITY OF OULU

- novel RFIDs, organic semiconductor devices
- functional composites for RF and microwave devices
- micro projectors, spectrometers
- shape memory (NiTi) implants for different purposes
- nanosurface coatings for materials interaction
- surface characterization of biomaterials
- new skin protection screens
- ultra high resolution 3D imaging
- intra cellular imaging
- photonics
- bio-nano-tools, sensors
- OLEDs



Nanostructure with FIB



*Nanoaperture with
~ 200 nm features*



*C-hook implant for
shoulder repair*



*Disposable biosensor on
flexible polymer substrate.*

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 - *Prof. Timo Jäämsä, Department of Medical Technology*
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 - *Prof. Markku Moilanen, Optoelectronics and Measurement Techniques Laboratory*
 - *Dr. Jukka Hast, Optoelectronics and Measurement Techniques Laboratory*
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 - *Dr. Tao Hu, Microelectronics and Materials Physics Laboratories*
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- *Research Group of Napero Project in VTT and Oulu University*

NTNE 2006 16-18 May 2006
Wanha Satama, Helsinki, Finland

Nanotechnology in Northern Europe Congress and Exhibition

Leading Nanotechnology Forum focusing on North European strengths



More information
www.nano.fi

Congress key themes

- Nanoelectronics and Nanophotonics
- Nanotechnology Instruments and Tools
- Nanotechnology and Safety

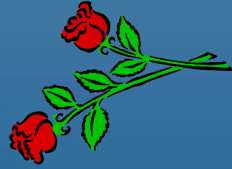
FinNano Annual Seminar on 18 May

Exhibition

- Extensive exhibition in connection with the congress



Infotech "Day of Science" in Oulu, 11th of Nov., 2005



MANY THANKS FOR YOUR ATTENTION!

Heli Jantunen