Master profile nanotech

Semester	Courses / Projects	ECTS	Type
Semester 8	Interface Optics Nanophysics Nanoproject	5 5 5	Profile Course Profile Course Profile Project
Semester 9	Micro- and Nanofabrication Nanoproject Thesis preparation	10 5 10	Profile Course Profile Project Profile Courses
Semester 10	Final Master Project	30	Profile Project

what you need to know to follow the profile:

Semester	Master of Science in Engineering – Mechatronics **Profile in Nanotechnology**																														
10.	**MTH** Master Thesis																														
9.	**NPRO 2** Nanoproject										**MICRO 2** Micro- and Nano fabrication										**MTH / Electives** Master Thesis / Electives									**MDB 2** Mechatronics Design and Build
8.	**NPRO 1** Nanoproject										**INFO** Interface Optics										**NPHYS** Nanophysics									**SME** Scientific Methods									**ESD** Embedded Software Design									**MDB 1** Mechatronics Design and Build
7.	**IECS or MICRO 1 and SURF** Introduction to Embedded Control Systems or Introductory courses MICRO 1 and SURF															**FEA** Finite Element Analysis					**NUA** Numeric Analysis									**COS** Control Systems									
ECTS POINT	1																														1

INFO, Interface Optics

Advanced knowledge of how to use **photonics methods in nanotechnology**. Background to identify appropriate optical methods to solve specific problems arising at nanoscaled interfaces.

- Surfaces and interfaces
- Linear optical properties of surfaces and interfaces
- Infrared spectroscopy
- Linear optical techniques
- Nonlinear optical techniques
- Optical microscopy
- Nano-optics
- Local spectroscopy

INFO, Interface Optics

Upon completion of this course you will be able to

explain basics of **interaction between light and surfaces** or interfaces

know in which way **optics** can be used to **investigate surfaces** and interfaces with nanotechnological importance

understand the difference between linear and nonlinear optics and how **laser**s

allow one to decipher unprecedented detail of morphology and dynamics of nanoscaled systems

explain methods to **overcome the diffraction limit**

understand the importance of the **optical near field**

NPRO1

The project will be usually executed in the following sequence:

- Short theoretical introduction to the problem
- Proposed solutions and comparison of existing systems
- Decision for the solution to go
- Exploration and improvement of the experimental set up
- Experimental data uptake
- Theoretical modelling and comparison with experimental data

In many cases the **results of the project could be extended in the final master thesis**.

The semester project will be executed by project groups consisting of 2 to 3 students, or individuals, if necessary. The students will receive the necessary explanatory lecturing and careful supervision, and will proceed with individual study and team work in solving the assignments given as project tasks. A written 20-30 pages report containing the findings and accumulated experience, will be delivered by each student individually to the secretary office at least 2 weeks before the oral examination.

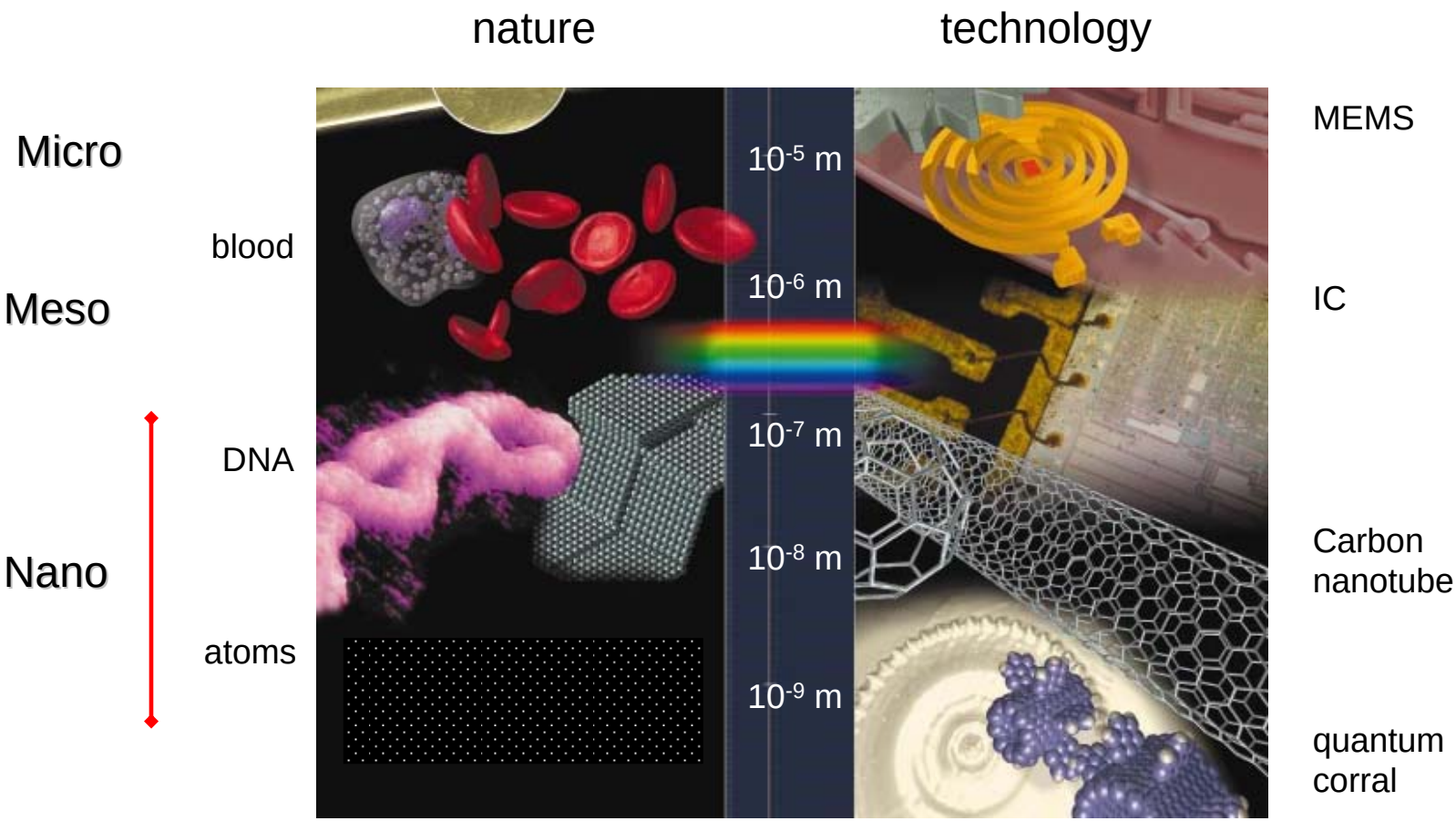
NPRO1

Development of an **ATR** (attenuated total internal reflection) **sensor** and measurement of contaminating organic layers. This includes applying thin film coating technology to form an ultrathin gold film on a glass prism, setting up an optical goniometric detection line including laser and detector, adsorbing organic thin films and performing reflection measurements. The experimental data will be compared with theoretical curves, allowing the students to draw conclusions about contaminating species and thickness of the adsorbed layer.

Overall competences

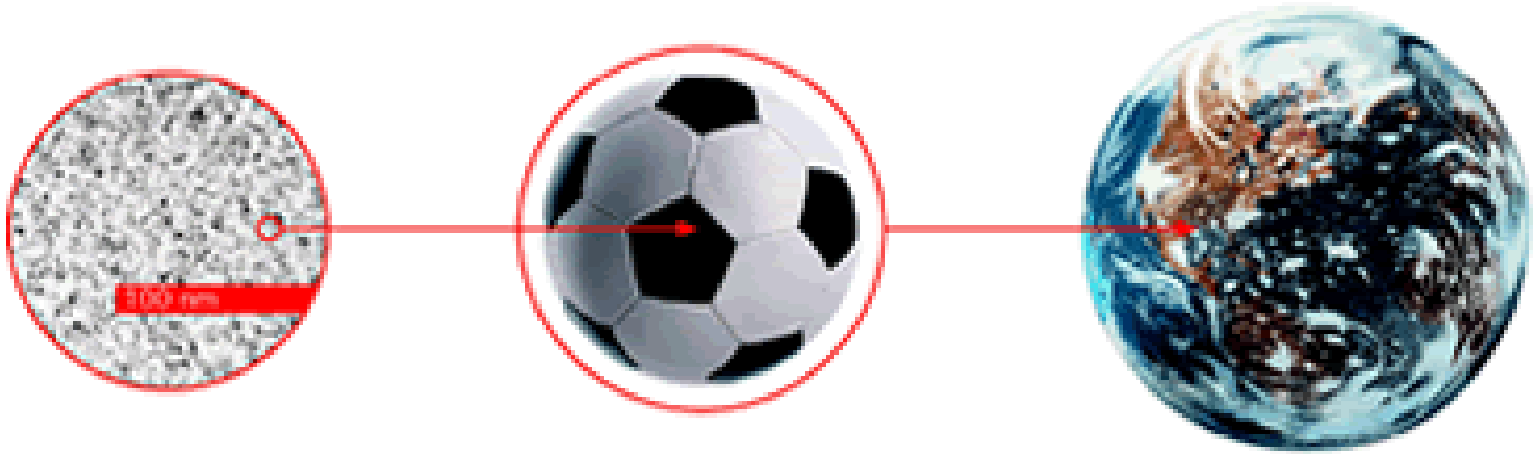
- a general knowledge about basics and modern trends in nanotechnology
- knowledge about the principle of micro- and nanofabrication methods
- the ability to independently work in a cleanroom
- the ability to identify appropriate semiconductor processing methods for micro- and nanoscaled devices
- knowledge of how to use photonics methods in nanotechnology
- a thorough understanding of the principles of micro- and nanoelectromechanical systems and the effects of low-dimensionality

What's so special in Nano ?



Nano - a new world

“nano is everything below 100 nm”



compared to a football

it is like the football compared to the world

There is a whole new world in a football filled with nanoobjects.

How real is 'nano' already today ?

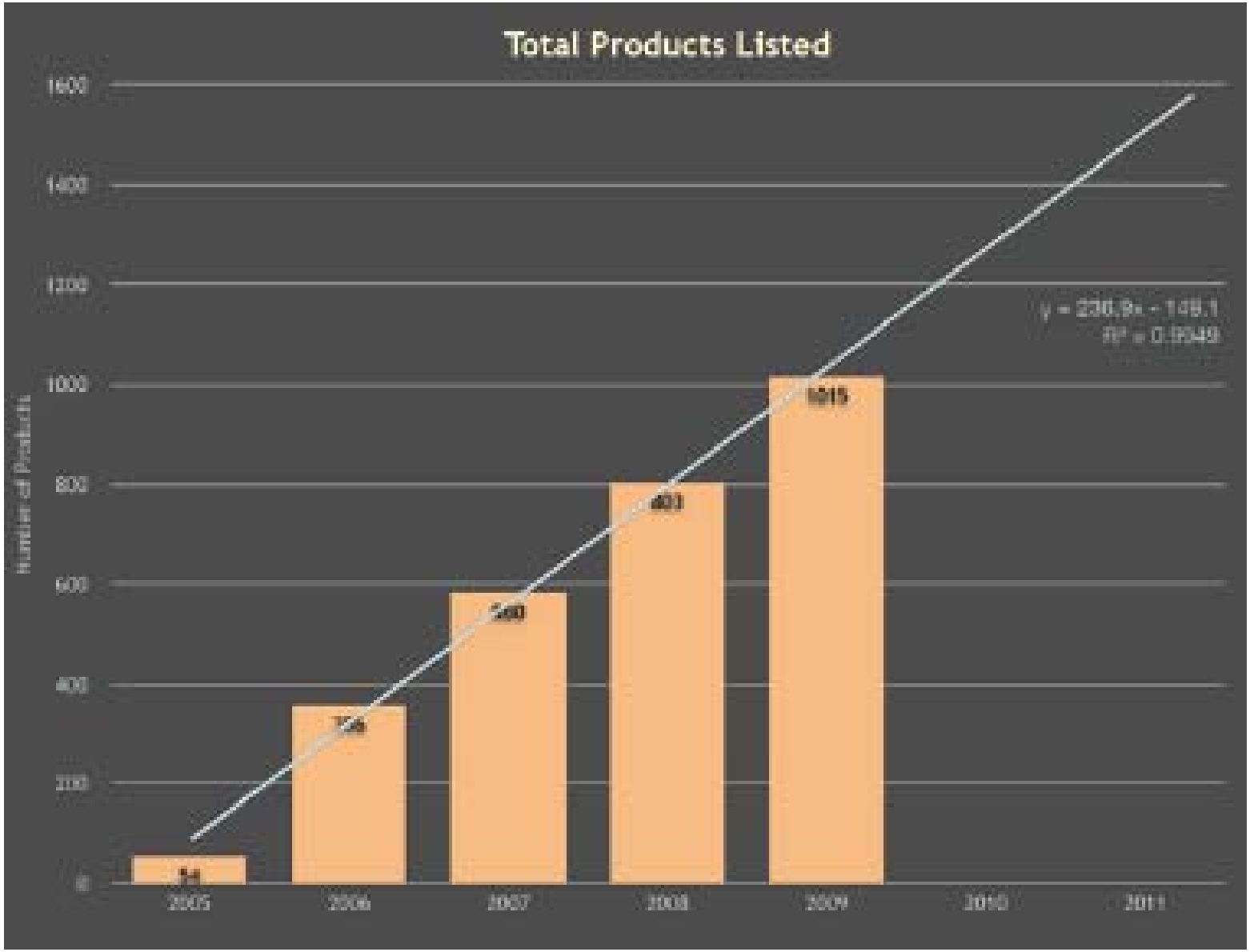
Lots and lots of colorful images …

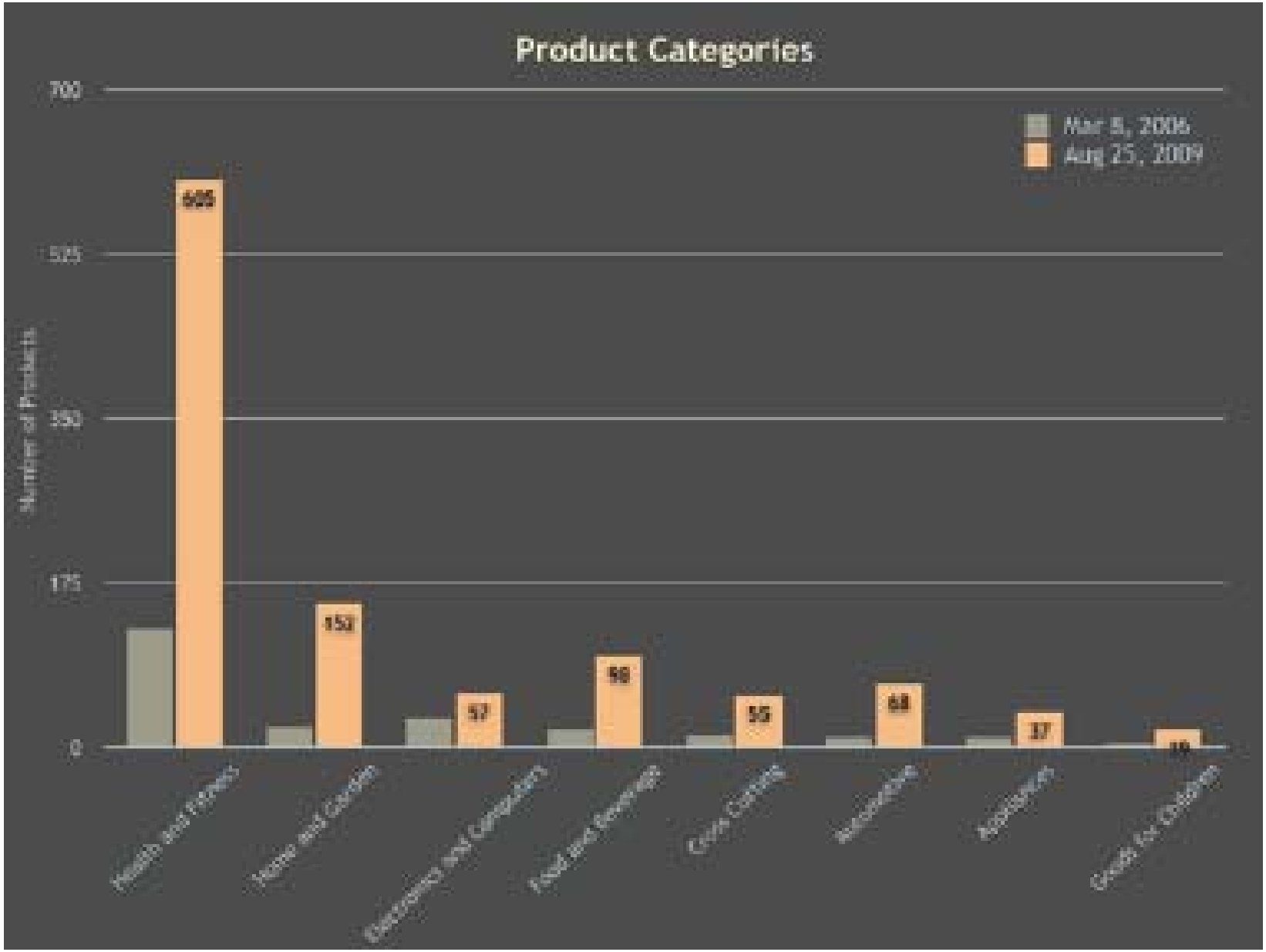
(but how much science is in these fictions ?)

Lots of marketing, labeling and niche products:

Car paints, antifog glasses, health care, drug delivery, cosmetics …

nano is a sum of many (1000) diverse products

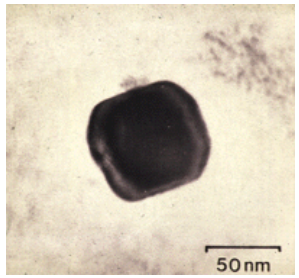

Total Products Listed
1600
1400
1200
1000
800
600
400
200
0
2005
2006
2007
2008
2009
2010
2011
1015


Product Categories
Mar 5, 2006
Aug 25, 2009
Number of Products
700
525
350
175
0
605
153
57
88
55
68
37
19
Health and Fitness
Home and Garden
Electronics and Computers
Food and Beverage
Cars, Culture
Miscellaneous
Appliances
Goods for Children

Nano-products

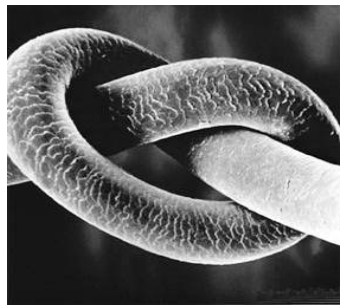
Particles

medico & cosmetics
sprays
food (especially functional food)



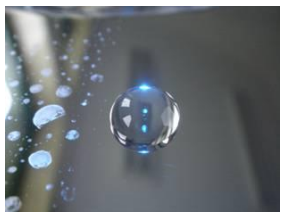
Fibers

textiles (polymers)
composite materials (carbon nanotubes)
sensors



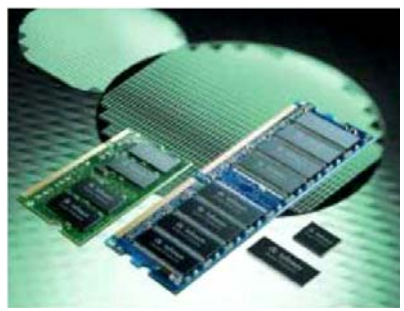
Layers

coatings (super-hydrophobic or –hydrophilic, thin films, emballage)
magnetic storage
light emitting layers



Structures

ICs
lasers and light diodes
biomimetic nanostructures



How to prepare nano-products

0D-Particles

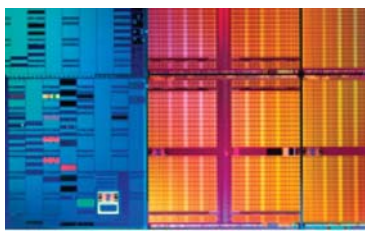
Grinding
Gas condensation
Chemistry (reduction, gel, colloids etc.)
Surface growth

1D-Lines, Fibers, Tubes ...

Surface growth
Solution growth

2D-Layers, Films ...

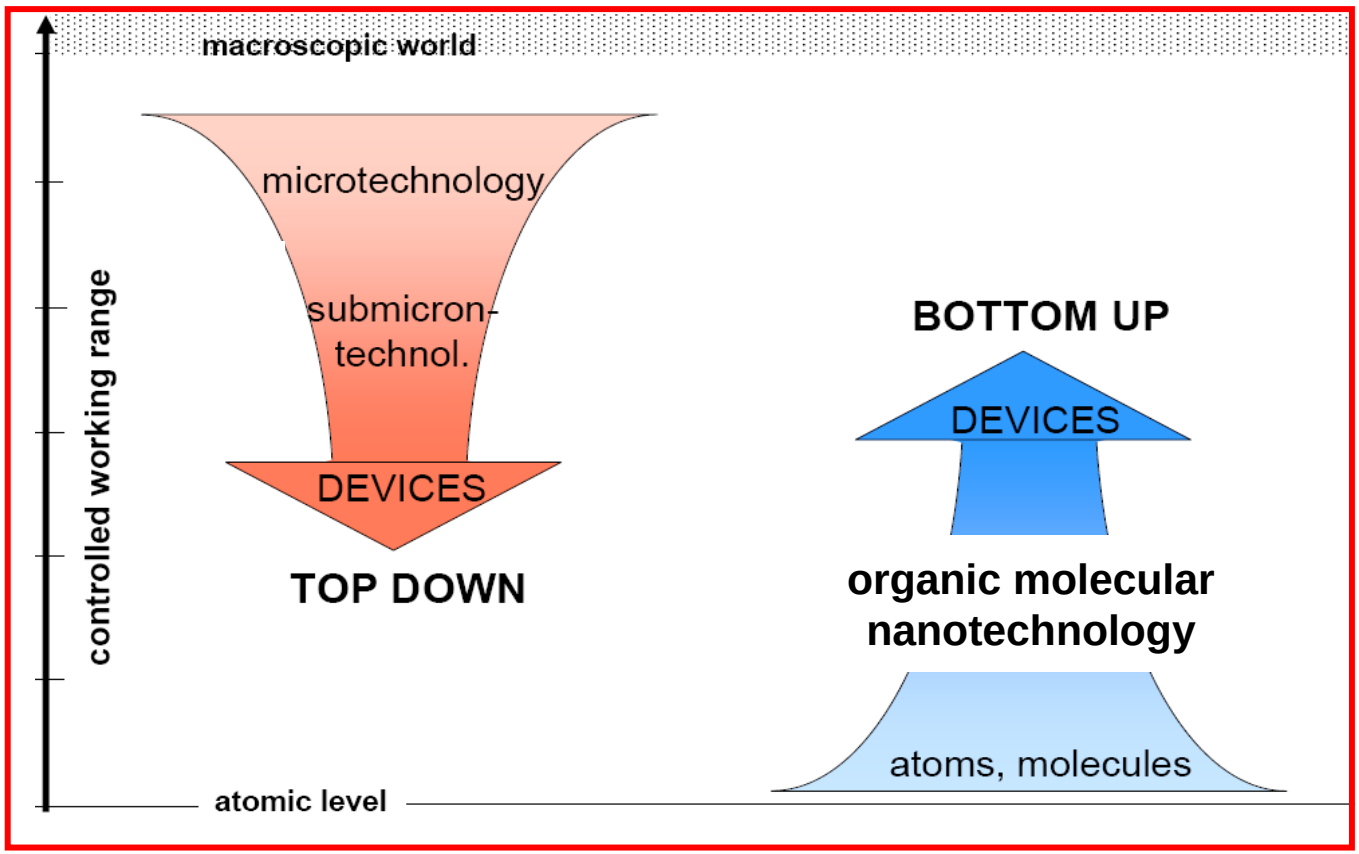
Physical Growth
Chemical Growth
Implantation



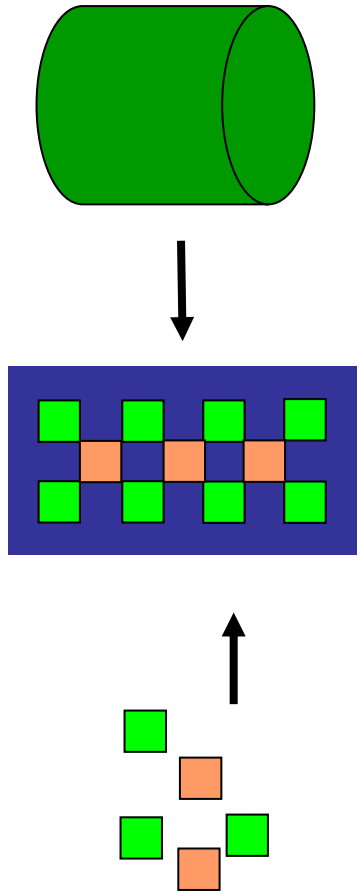
3D-Structures

Lithography + layer growth
Beam milling + layer growth

Top down vs. bottom up nanotechnology



sculpt from bulk



assemble from
nano building blocks

Nanotechnology

what to do with a master in nanotechnology?

Research and Development
University positions – PhD programmes
Project manager
Consultant
Project sales
Teaching

Surface coatings: mechatronics, bio, food, medico etc.
analysis of small particles and thin films
semiconductor industry
instrument industry, including development and sales

Bachelor and Master profile nanotech

Semester	Course title	ECTS	Resp.	Course title	ECTS	Resp.		ECTS	Resp.		ECTS
4 02/10	Introduction to nano / INANO	5	HGR/ MS	Waves and quanta/ WAQ	5	FB	Project I	5	HGR /MS		
5 09/10	ISA 1	5	NLA	Cleanroom microfabrication / MICRO 1	5	JKH	Surface Technology /SURF	5	FB	Project II	5
8 02/11	Interface Optics/INFO	5	HGR/ VB	Nanophysics/ NANOS	5	JE	Project III	5			
9 09/11	Micro- and Nanofabrication / MICRO2	10	JE/JK H/FB	Project IV	5					Thesis prep.	10
10											