



Social Implications of Nanotechnologies

Background information on Nanotechnologies

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Social Implications Nano?

- Industrial change
- Changes of organisational structures
- Employment
- Role of Trade Unions
- Role of Works Councils
- Working conditions
- New materials
- New products
- Ethical issues
- Privacy issues

This presentation

- Project NanoCap
- Nano definition and properties
- Some examples of nanoproducts
- Workers interests and concerns

NanoCap

NanoCap

- Project FP6 Science & Society
- Capacity building NGOs and Trade Unions focussed on NT
- Support positioning within nanodebate
 - Environmental issues
 - Occupational health and safety issues
 - Ethical issues
 - Critical assessment of benefits

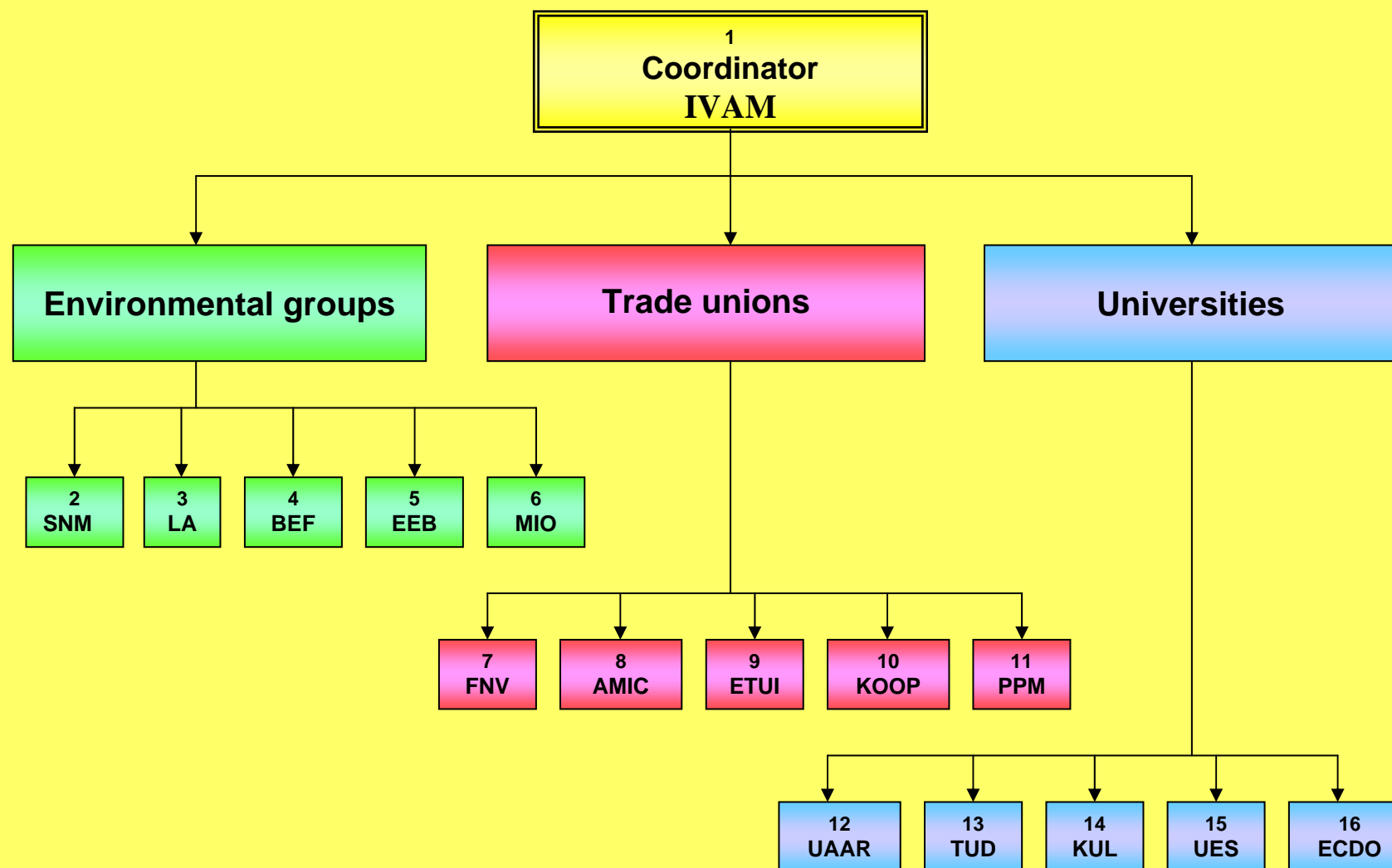
Activities

- working conferences
- discussions with industry and governments
- dissemination activities to members and general public

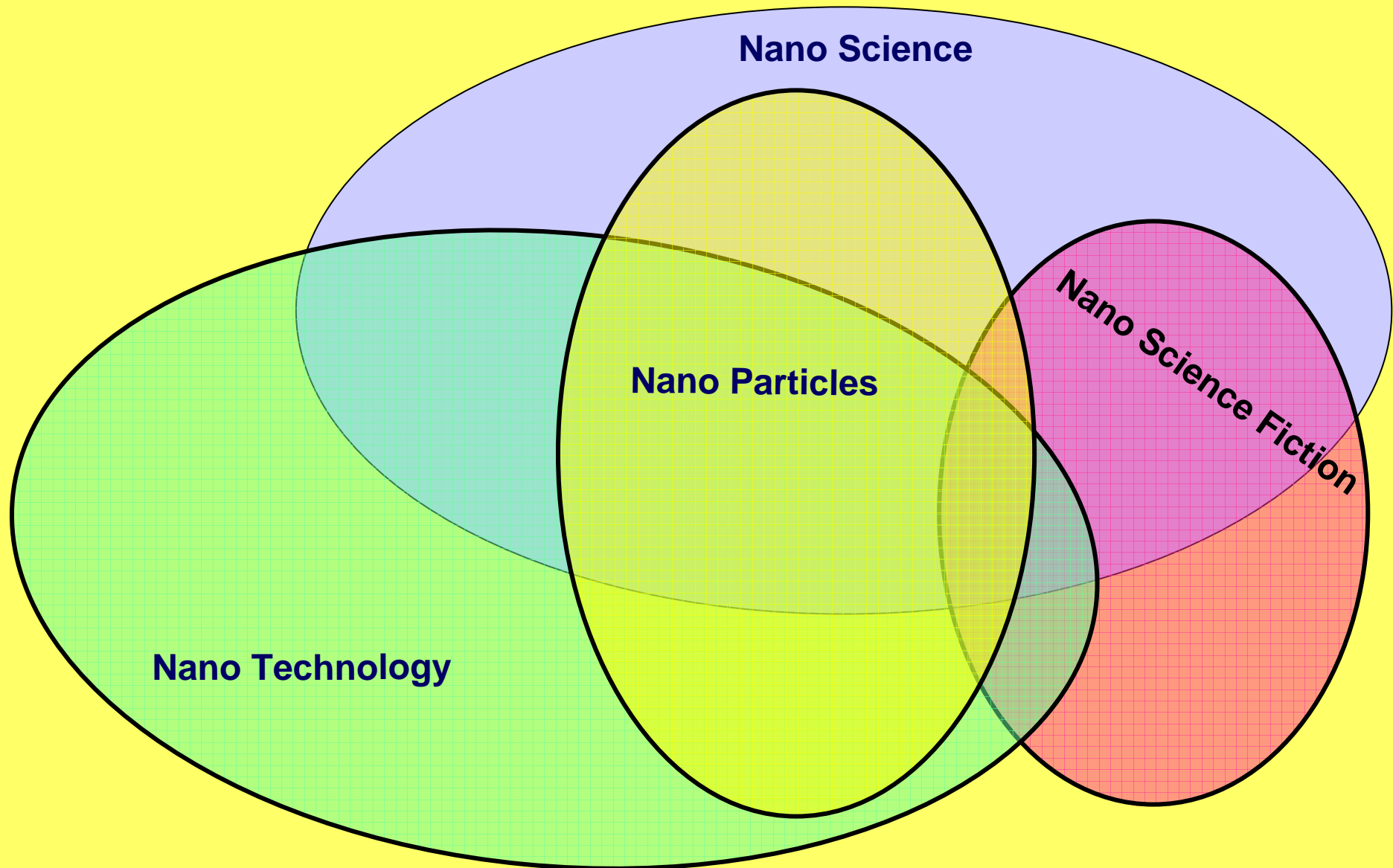
Period

- Sept 2006 – Sept 2009

NanoCap consortium



Nano terminology



Nanoparticles (NP)

■ NP < 100 nm

- $1\text{ nm} = 0.001\text{ }\mu\text{m} = 0,000001\text{ mm} = 0,0000000001\text{ m} = 10^{-9}\text{ m}$
- Atoms $\sim 10^{-10}\text{ m}$ Molecules $\sim 10^{-9}\text{-}10^{-8}\text{ m}$

■ Non-manufactured “well-known” NPs

- Industrial pollutants: *Diesel-exhaust, welding fumes*
- Natural pollutants: *Sea salt, forest fire smoke, vulcanism*

● Manufactured NPs

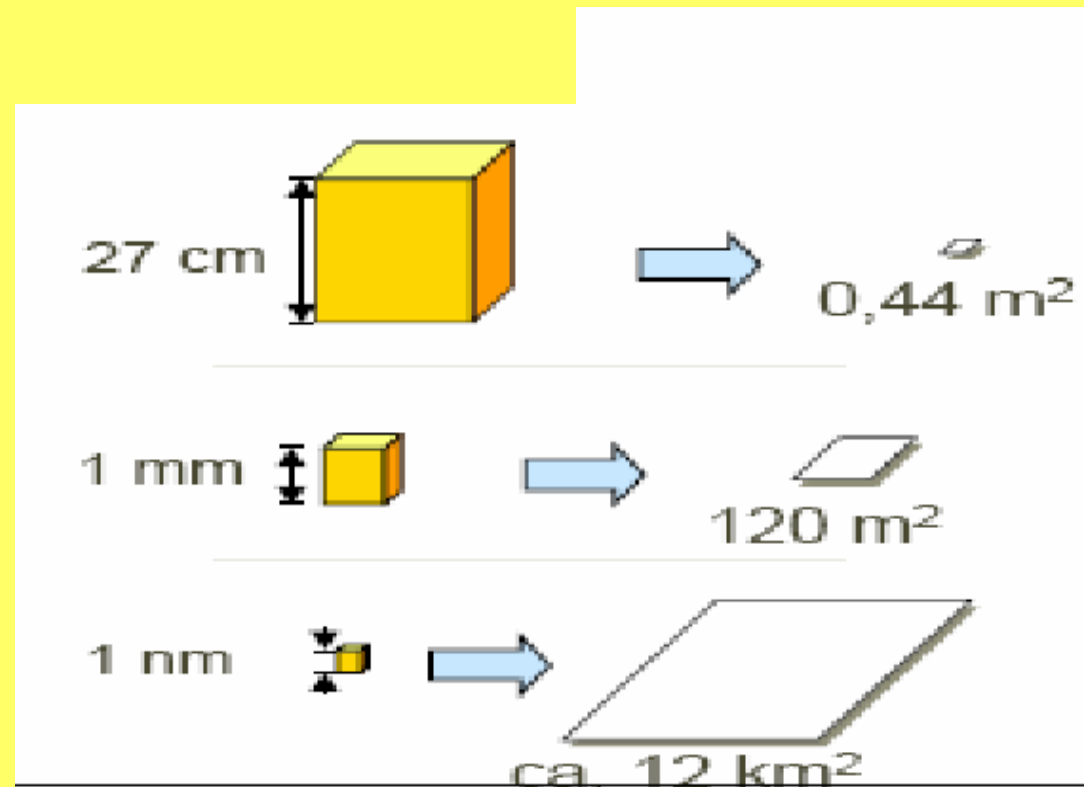
- Well-known ‘old’ products: *carbon-black, asbestos*
- many new developments:

Important NP properties

- Size (nano)
- Dimension:
 - 1D (surface), 2D (rod, tube, needle..), 3D (sphere)
- Form
 - Crystal, amorphous, porosity
- Water-solubility
- Persistence (biodegradability)
- (Photo)reactivity
- Charge
- Etc.

NPs' enlarged surface

- **Toxic effect surface-based rather than mass-based**
 - The same weight of substance in the form of nano-particles has a much larger surface than in the form of the large particles



Consequence of larger surface on toxicity

- **Example calculation of Nano-OEL**
- **based on different size of active surface area**

.....**TiO₂**: Actual (NIOSH-US) OEL **1,5mg/m³**

————→ **nano-TiO₂**: NIOSH–calculation: **0,1mg/m³**

Behaviour of NPs

- **Shape, crystal structure, aggregation and surface structure important determinants of hazard**
 - Surface activity may generate toxic effect
- **Many new combinations of substances**
- **Airborne NPs behave as a gass**
 - NP (ca.50nm) Deposition preferably in deep lungs (alveoli)
- **NPs might penetrate the skin**

Many types of NPs

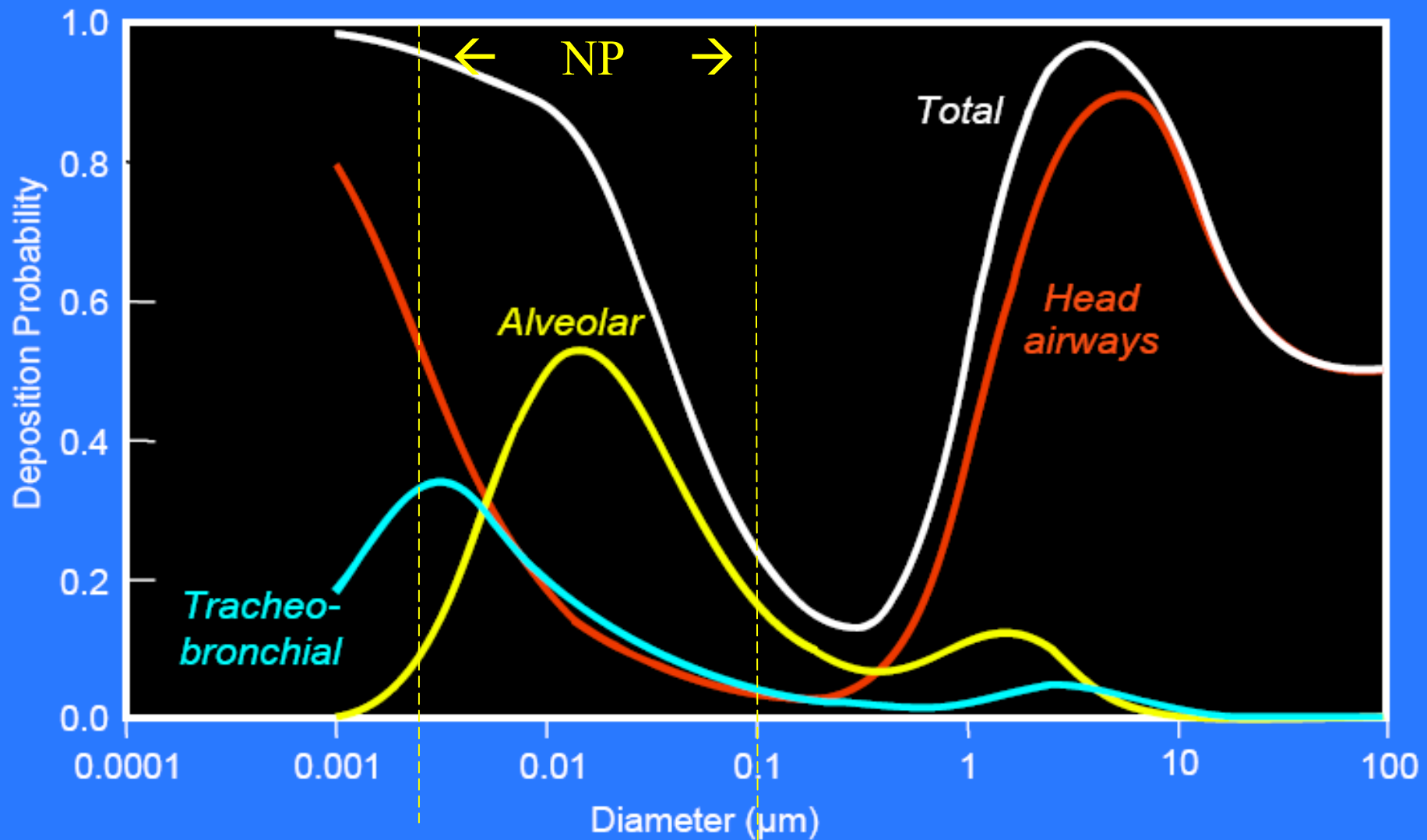
■ **Nanosized versions of 'old' substances**

- TiO_2 (cosmetics: sun tan cream, glidant in powders, water & dirt repellent at glass windows and textiles)
- SiO_2 = silicium dioxide (coatings, chips, tooth paste...)
- Ag (biocidal, hygienic purposes)
- Fe etc. (environmental remediation)
- Al

● **New nanomaterials**

- 'fullerenes' (or 'buckyballs')(lubricant, adsorber, ...)
- carbon nanotubes (filler epoxy, tennisracket, ropes, medines, screens, electronics..)
- new combinations of substances

Predicted deposition of inhaled particles in the human respiratory tract



ICRP (1994) model: adult, nose breathing, at rest

Growing amount of NP products at the market



Construction industry example



Bioni Hygienic:

- Anti microbial Wall Coating
- Acryl-Dispersion with Nano Silver Suspension (~13nm)



On MSDS:

No special measures mentioned

Construction industry example

Insulair NP, insulation blankets

- Flexible, **nano**-porous gel, nano “bubbles”



Construction industry example

EMACO® Nanocrete,

- Structural repair of concrete elements
- contains: Silica fume (SiO_2 **nano**-particles)



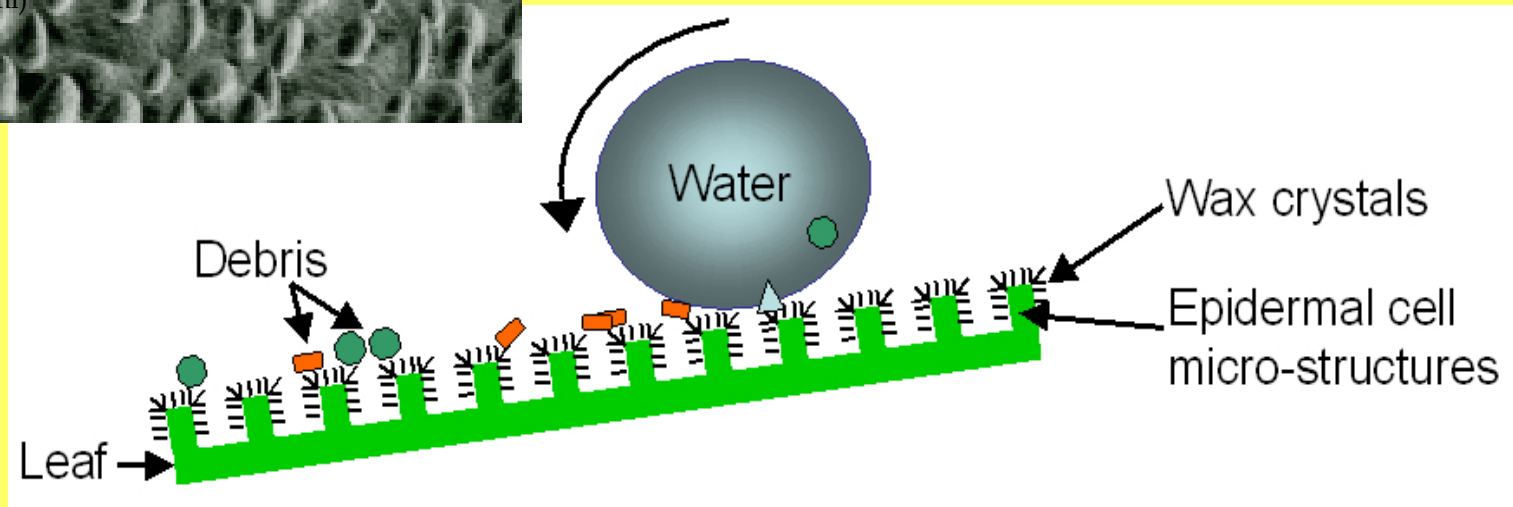
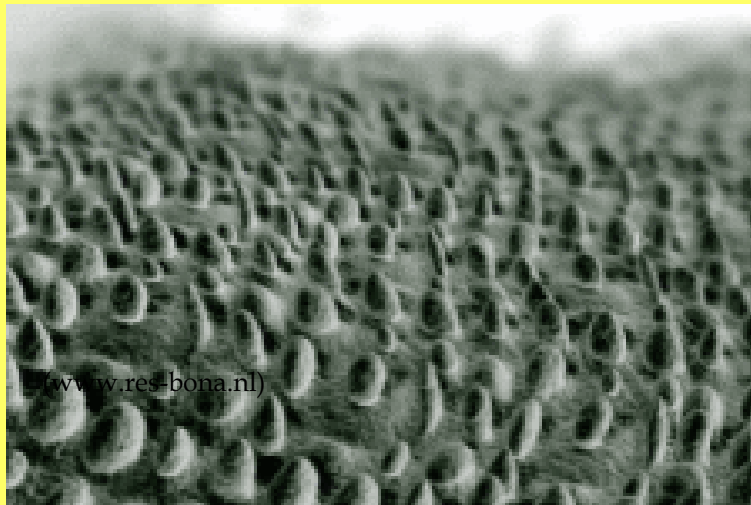
MSDS: Xi: Irritant

R37/38 Irritating to respiratory system

R41: Risk of serious damage to eyes

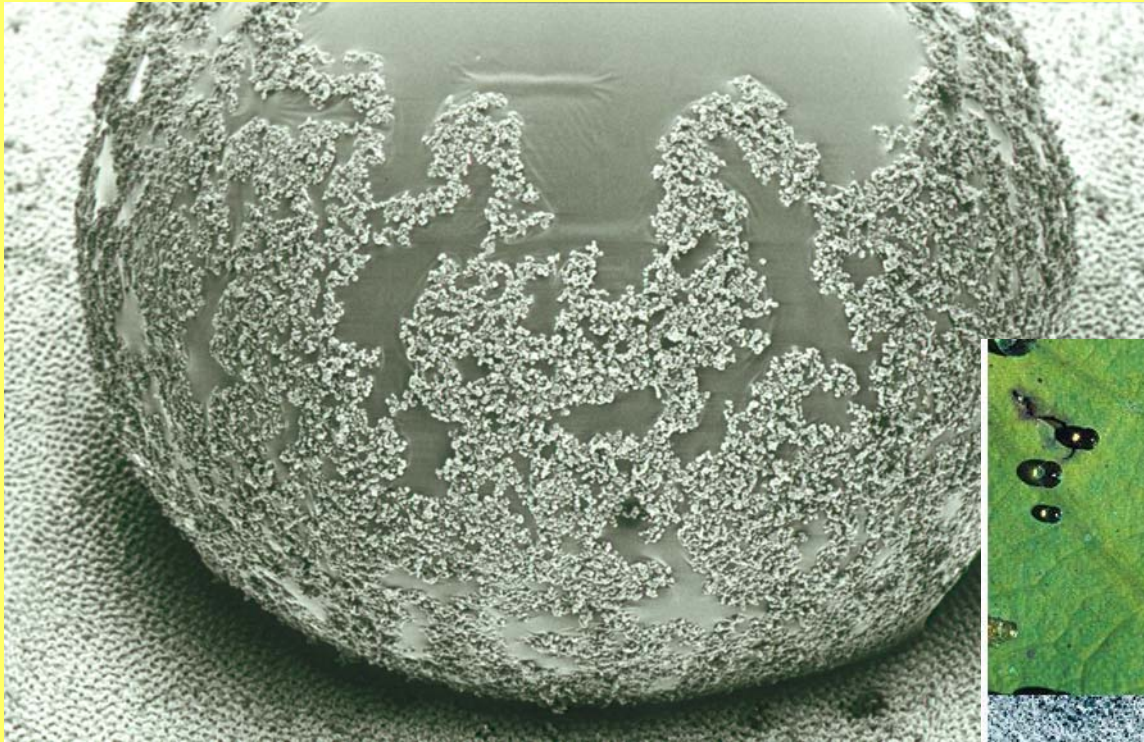
The lotus effect

- Self-cleaning effect based on extremely water-repellent behavior known as superhydrophobia.
- “Papillae” on the leaf, about 5 to 10 micrometers high are themselves coated by a fine nanostructure of wax crystals.



The lotus effect

Water droplets form spherical globules that easily roll off of leaves only slightly inclined. Particles of dirt become absorbed and removed.



(www.corporate.basf.com)



Who might be at risk?

■ **Exposure to nanomaterials**

- Production/handling/packaging & maintenance/cleaning workers
 - Transport workers
 - Secondary users
 - End-users and consumers
 - Disposal
-
- Normal operations, accidents (leaks)
 - Inhalation, dermal and other routes of exposure

Workers' interests in nanotechnologies

- Safe workplace
- Precautionary approach in case of lacking data
- Full compliance with current legislation
- Development of responsible nanotechnologies
- Environmental compatibility

Workers' concerns on nanotechnologies

- Lacking toxicological data (for pure and “contaminated” substances) for short and long-term adverse effects
- Lacking info on physical and environmental behaviour of NP
- Lacking information on exposed groups
 - Type, amount of exposure, exposed workers, inhalation/skin,
 - Exposure during manufacturing, processing, use, waste, cleaning, maintenance
- Effectiveness of control measures
- Insufficient knowledge
 - of the companies' (safety) management
 - of occupational physicians
 - and limited handling perspective of labour inspector
- Extreme competition resulting in “*no-time*” management

Workers' concerns on nanotechnologies 2

- Industry and governments intend to have an open public nano debate, but apparently they prefer an orchestrated debate
- Strong competition in nano-industry
 - confidentiality about NP-products and production
 - Limited info on risks
 - Limited accession to products composition
 - Limited accession to workplace measurements
 - Agreements on not analysing purchased NP raw materials
 - Strong competition resulting in “*no-time*” management

Workers' interests in nanotechnologies

Safe Workplace

- Exposure control
 - Identify workers potentially exposed
- Full information on chemicals and products at the workplace
- Full information on lacking (eco)toxicological data
 - indication on SDS!
- Selection of low- / non-toxic chemicals
- Involvement in risk assessment and risk management
- Involvement in exposure monitoring
- Nano-adapted occupational health surveillance
- Appropriate training

Workers' interests in nanotechnologies

Precautionary approach

- Transparency on lacking data and knowledge
 - Statement on SDS informing about lack of data
 - Introduction R-phrase stating “insufficient knowledge to determine risks”
 - No data → no exposure

- Formalise the role of:
 - **Workers' representatives** in design and monitoring of a safe workplace
 - **Labour Inspectorate** in control and enforcement of compliance with the “voluntary” agreements made in Code of Conducts.

- Specify nanoparticles
 - in different property groups (chemical reactivity, toxic action etc.)
 - **NPs are not all the same → don't communicate them as equal !!**

Workers' interests in nanotechnologies

Compliance with legislation

■ Full compliance with REACH:

- Most NPs can be considered as existing substances, "only the size is special"
- Therefore substances with production volumes >10 tpa
→ **Chemical Safety Report** (CSR) *for intended use*
also for the use as NP!!

■ Demand:

- CSR obligatory for *all* substances used at nanoscale (also those <10 tpa)
- DNEL for *all* substances used at the nanoscale (also those <10 tpa)

■ *No data → no market*

Workers' interests in nanotechnologies

Responsible Nanotechnologies

- Complying with codes of conduct
 - “Company specific CoC
 - (UK-Industries’) Responsible NanoCode
 - EC CoC for responsible NS and NT
 - Swiss retailers code of conduct IG DHS
- Production of safe nanoproducts
- Identify users potentially exposed
- Transparent ethical considerations concerning product design and development
- Don’t over-emphasize the potential NT benefits

Workers' interests in nanotechnologies

Environmental Compatibility

- Identify nanotechnological activities and consequences that may cause harm ***along the whole life cycle***
 - Nanoparticles / nanostructures
 - Non-soluble
 - Badly biodegradable
 - Disperse use or disperse fate

- Don't allow products at the market containing or generating:
 - dispersive
 - non-biodegradable
 - toxicnanoparticles, without proper environmental safety assessment

- Don't allow non-sense nanoproducts at the market

NanoCap 2006 – 2009

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