Nanotechnology and Society in the Center for Biological and Environmental Nanotechnology

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International Council on Nanotechnology
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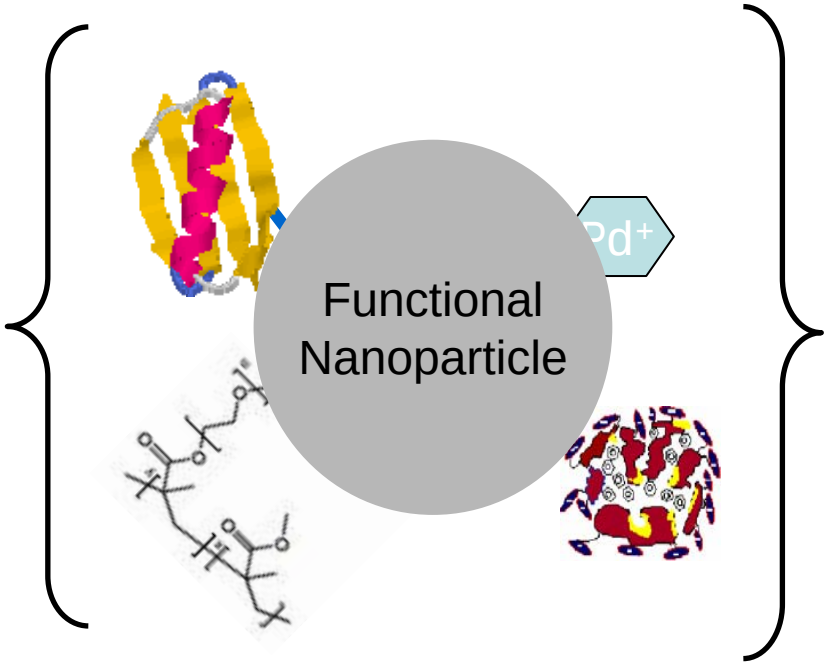
CBEN's Mission

To create sustainable nanotechnologies that improve human health and the environment



Theme 2: Nanoparticles for Bioengineering

Theme 1: Nanoscience at the Wet/Dry Interface

Theme 3: Nanoparticles & Environmental Engineering

Addressing *applications* and *implications* since 2001

Project 1: Ethics and Politics of Nano

- Research goals
  - Investigate emergent social, ethical and political issues surrounding nanotechnology
  - Stimulate dialogue between anthropologists and nanotechnologists
- Type of grant
  - Supplement to NSEC
- Thematic areas
  - Nanotechnology, public spheres and public relations
  - Fundamental research into ontology
  - Research on “politics and ethics”

Chris Kelty (ANTH)

Hannah Landecker (ANTH)

Project 2: Public Trust/Perceptions of Risk

- Research goals
  - Identify public attitudes toward the risks and benefits of nanotechnology as compared to other technologies such as genetically modified organisms, stem cells, biotechnology and nuclear power.
  - Identify how the public weighs the risks and benefits of certain nanotechnology applications.
  - Identify how the public assesses the actions of regulators and manufacturers when deciding to use a new medical product containing nanotechnology.
- Type of grant
  - Supplement to NSEC
- Thematic areas
  - Nanotechnology, public spheres and public relations
  - Fundamental research into ontology
  - Research on “politics and ethics”

Steven C. Currall (PSYC/STAT/MGMT)

Currall, S. C., E. B. King, et al. (2006). "What drives public acceptance of nanotechnology?" Nature Nanotechnology **1**(3): 153-155.

Project 3: ICON

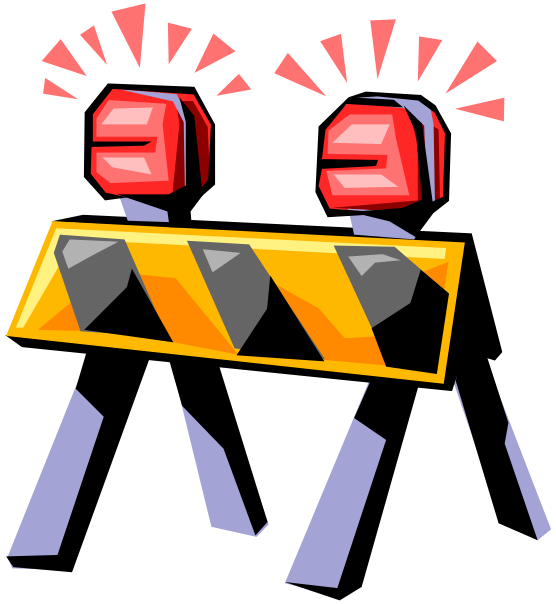
The International Council on Nanotechnology (ICON)

- Project goals
  - Develop and communicate information regarding potential health & environmental risks of nanotechnology
  - Foster risk reduction while maximizing societal benefits
  - Stimulate dialogue and action amongst diverse stakeholders in an international setting
- Type of grant
  - Part of NSEC
- Thematic areas
  - Nanotechnology environment, health & safety
  - EHS Database
  - Best practices for safe handling of nanomaterials in the workplace (UCSB)
  - International cooperation
  - Multistakeholder coalition

Kristen M. Kulinowski
(CHEM)

Barriers to effective risk management

1. Knowledge about nano risk
   - $$ for risk research
   - Strategic risk research prioritization
2. No structure-function relationships
3. Standards in terminology, metrology, EHS
4. Uncertain regulatory environment
5. Transparency, responsiveness to public concerns (Currall)



How can societal stakeholders work together to address these issues?

International Council on Nanotechnology

INCLUSIVE

All stakeholders communicate and cooperate in nanotechnology EHS

GLOBAL

A global perspective on the potential risks of nanotechnology

Developing and communicating information regarding potential environmental and health risks of nanotechnology to foster risk reduction and maximize societal benefit.

TECHNICAL

High quality technical information and knowledge for all levels

PROACTIVE

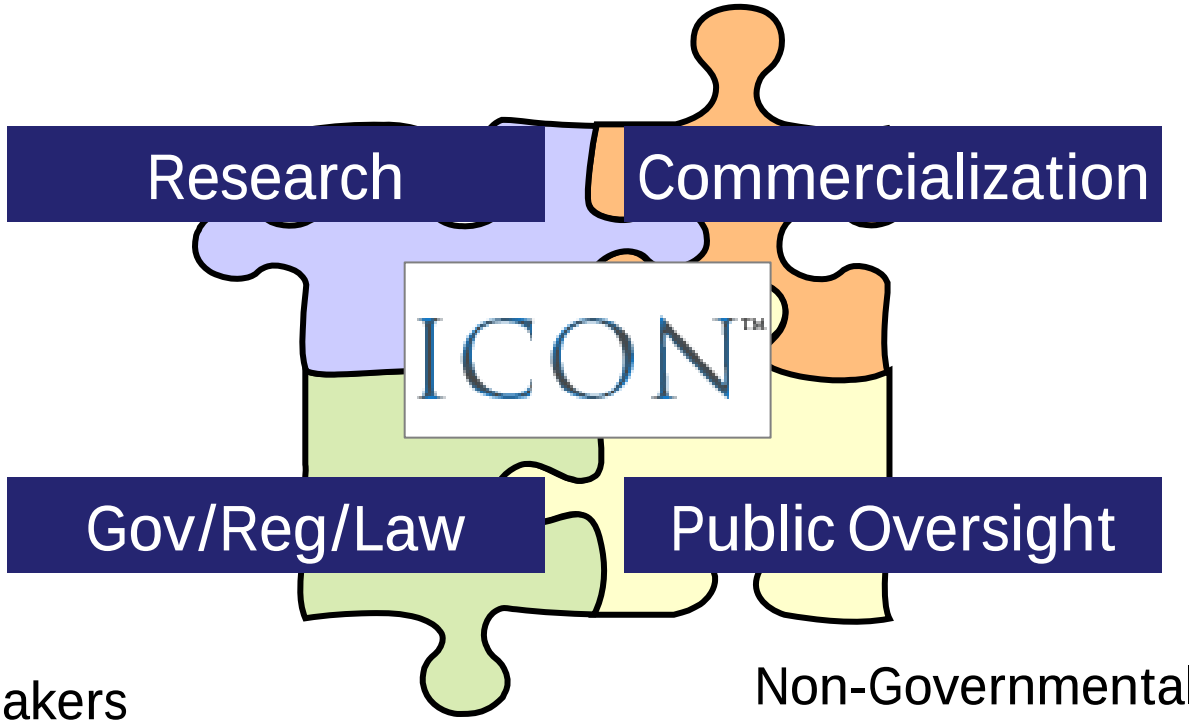
Stewardship for sustainable nanotechnology

ICON is a program of the Center for Biological and Environmental Nanotechnology, our “industrial affiliates” program, **BUT**…

CBEN

A New Model for Interaction

Academics
Industry
Government



Industry
Trade Groups

Gov Policy Makers
Regulators
Lawyers

Non-Governmental Organizations
Social/Ethical Researchers

Our members don't just participate, they govern

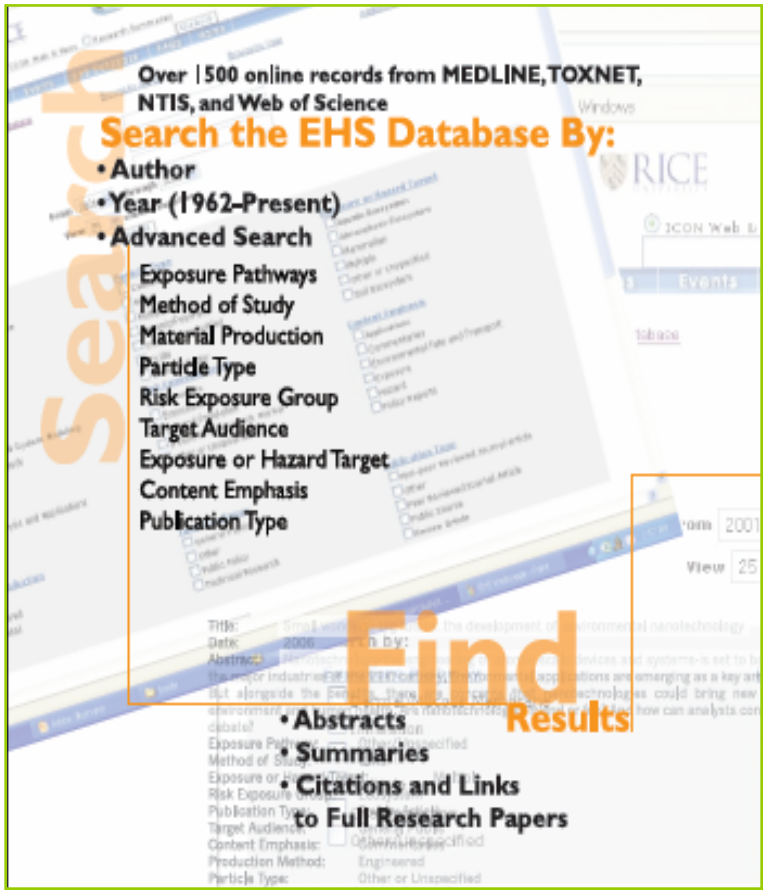
CBEN

Problem 1: Info on Nano Risk

What is known about nano environmental health and safety?

- Papers in diverse journals
  - Nano Letters to Toxicology Letters
- Nano EHS a very small fraction of total nano papers, search terms not well-defined
  - Needle in haystack
- No one index contains all papers
  - Web of Science, PubMed, ToxLine,…
- Results not accessible to general public

Environment Health & Safety Database

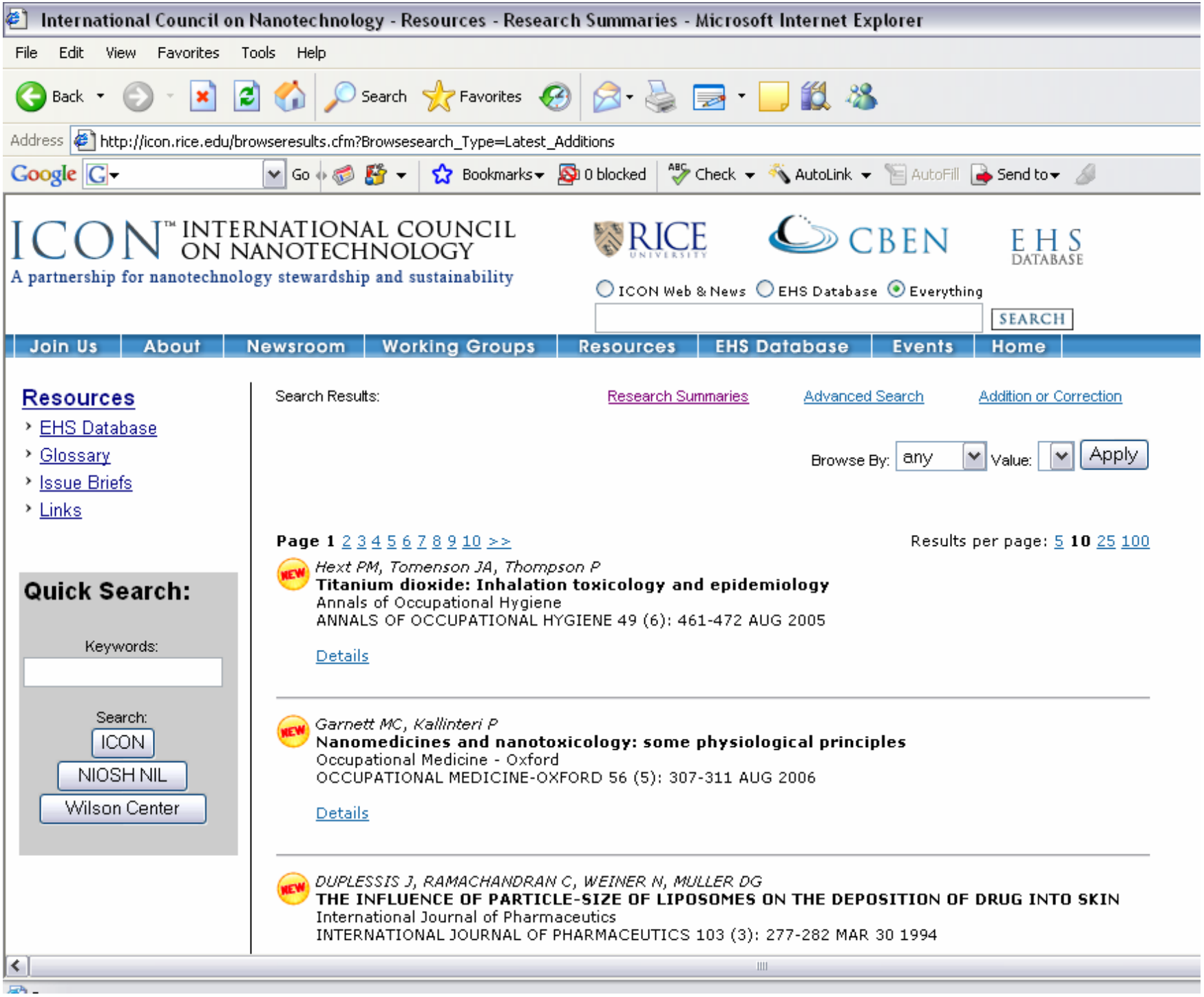


Database of cites to peer-reviewed nanoEHS papers

http://icon.rice.edu/research.cfm

- Launched August 2005
- Fully searchable, indexed
- Regularly updated
  - Over 1700 records
- Free to public
- Accessed by people around the world

Make sure YOUR work is in the database!


International Council on Nanotechnology - Resources - Research Summaries - Microsoft Internet Explorer
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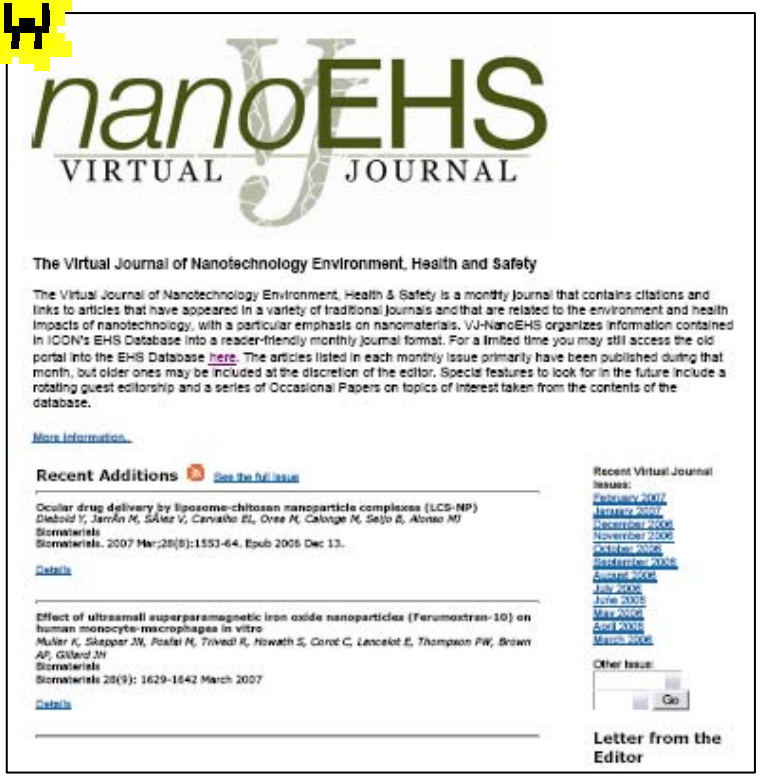
NIOSH NIL
Wilson Center
Search Results:
Research Summaries
Advanced Search
Addition or Correction
Browse By: any Value: Apply
Page 1 2 3 4 5 6 7 8 9 10 >>
Results per page: 5 10 25 100
NEW
Hext PM, Tomenson JA, Thompson P
Titanium dioxide: Inhalation toxicology and epidemiology
Annals of Occupational Hygiene
ANNALS OF OCCUPATIONAL HYGIENE 49 (6): 461-472 AUG 2005
Details
NEW
Garnett MC, Kallinteri P
Nanomedicines and nanotoxicology: some physiological principles
Occupational Medicine - Oxford
OCCUPATIONAL MEDICINE-OXFORD 56 (5): 307-311 AUG 2006
Details
NEW
DUPLESSIS J, RAMACHANDRAN C, WEINER N, MULLER DG
THE INFLUENCE OF PARTICLE-SIZE OF LIPOSOMES ON THE DEPOSITION OF DRUG INTO SKIN
International Journal of Pharmaceutics
INTERNATIONAL JOURNAL OF PHARMACEUTICS 103 (3): 277-282 MAR 30 1994

Next Steps

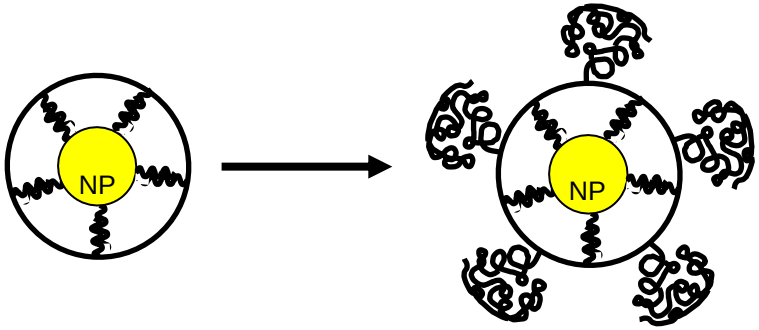
Database → Knowledge Base

- Implement virtual journal format
  - Backgrounders on key literature
  - Summaries of significant papers
  - Guest editorials on breaking topics
- Maintain monthly updates
- Post actual papers
- Seek broader integration of databases

NEW

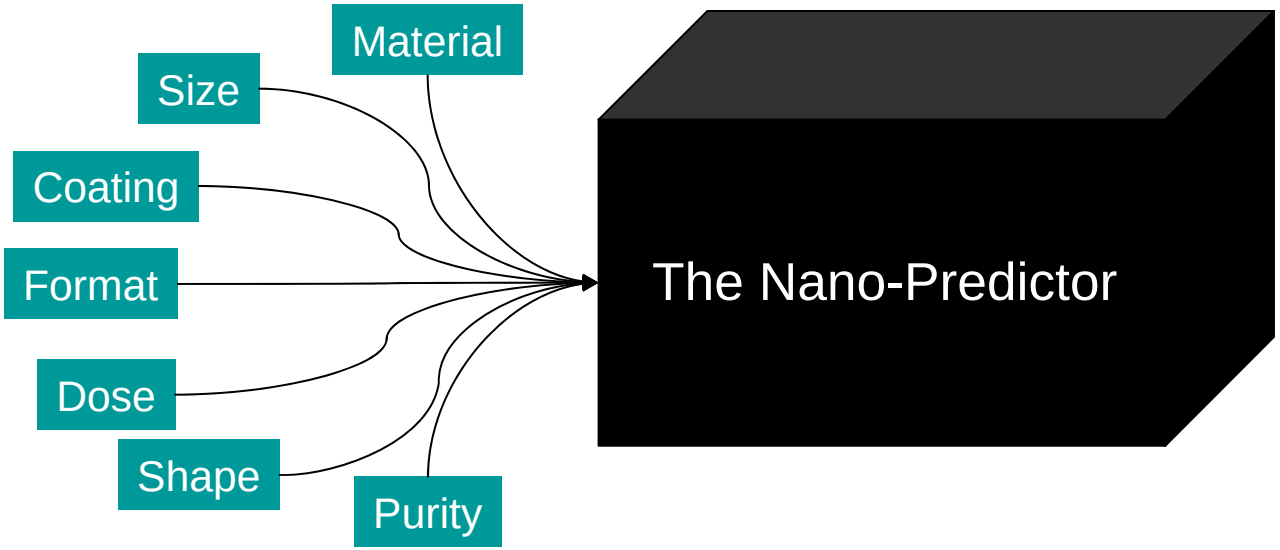


Problem 2: No QSAR



Native NP NP in body?

In vitro → *In vivo*



High probability of risk

Low probability of risk

NP = Nanoparticle

Adapted from V Colvin

International Research Needs Assessment

Goal: Define research strategies for developing "predictive nanotoxicology"

Workshop 1

- Catalogue nanomaterial physico-chemical properties by particle class
- Identify "hot spots" in lifecycle where hazard or exposure are high

Jan 2007 at NIH campus

Workshop 2

- Mechanisms of nano-biological interactions
- Interactions at cell-free, cellular, tissue and whole-animal levels

Jun 2007 in Zurich, Switzerland

Co-funded by NSF and ICON

Towards Predicting Nano-Bio Interactions

Define research strategies for developing predictive models of engineered nanoparticles' interactions with biological systems

Discussion Topics

- Mechanisms of nano-biological interactions
  - oxidative stress
  - protein misfolding
  - inflammation and immune response
  - apoptosis and necrosis
  - genotoxicity and mutagenicity
  - developmental effects
- Interactions at cell-free, cellular, tissue and whole-animal levels

Problem 3: No standards

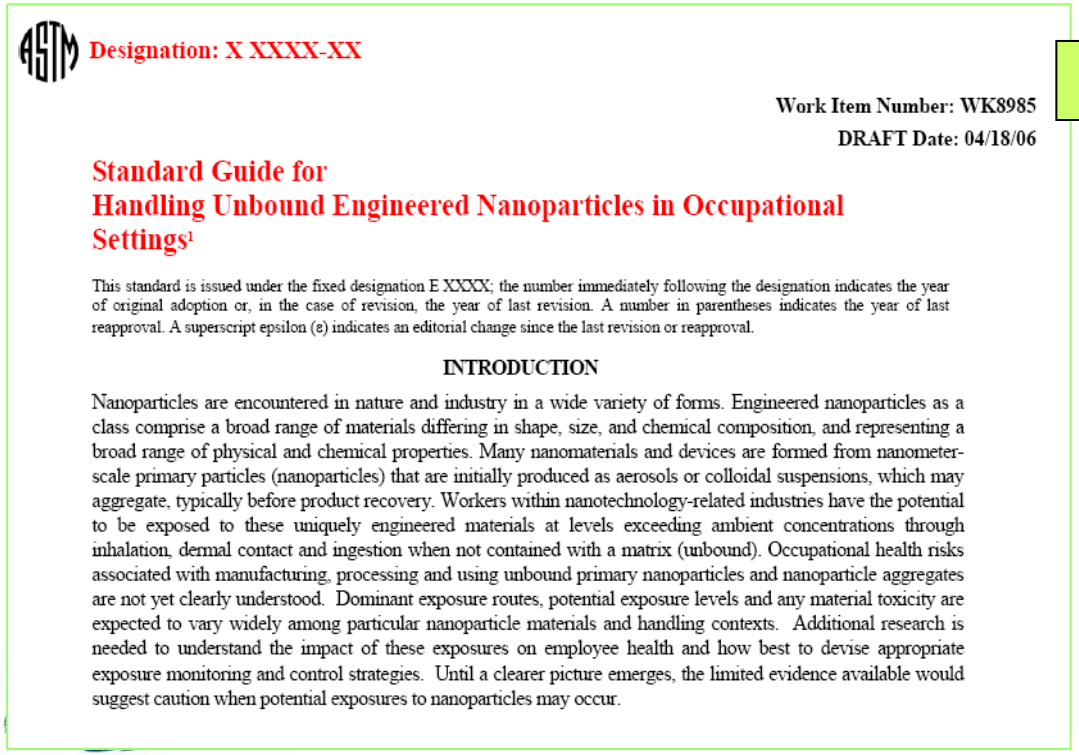
ASTM Standards under Development

Terminology for nanotechnology

- ★ 13 terms have been approved
- ★ Document publicly available

nanoparticle, *n—in nanotechnology*, a sub-classification of ultrafine particle with lengths in two or three dimensions greater than 0.001 micrometer (1 nanometer) and smaller than about 0.1 micrometer (100 nanometers) and which may or may not exhibit a size-related intensive property.

DISCUSSION—This term is a subject of controversy regarding the size range and the presence of a size-related property. Current usage emphasizes size and not properties in the definition. The length scale may be a hydrodynamic diameter or a geometric length appropriate to the intended use of the nanoparticle.



Designation: X XXXX-XX

Work Item Number: WK8985
DRAFT Date: 04/18/06

Standard Guide for Handling Unbound Engineered Nanoparticles in Occupational Settings[1]

This standard is issued under the fixed designation E XXXX; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

INTRODUCTION

Nanoparticles are encountered in nature and industry in a wide variety of forms. Engineered nanoparticles as a class comprise a broad range of materials differing in shape, size, and chemical composition, and representing a broad range of physical and chemical properties. Many nanomaterials and devices are formed from nanometer-scale primary particles (nanoparticles) that are initially produced as aerosols or colloidal suspensions, which may aggregate, typically before product recovery. Workers within nanotechnology-related industries have the potential to be exposed to these uniquely engineered materials at levels exceeding ambient concentrations through inhalation, dermal contact and ingestion when not contained with a matrix (unbound). Occupational health risks associated with manufacturing, processing and using unbound primary nanoparticles and nanoparticle aggregates are not yet clearly understood. Dominant exposure routes, potential exposure levels and any material toxicity are expected to vary widely among particular nanoparticle materials and handling contexts. Additional research is needed to understand the impact of these exposures on employee health and how best to devise appropriate exposure monitoring and control strategies. Until a clearer picture emerges, the limited evidence available would suggest caution when potential exposures to nanoparticles may occur.

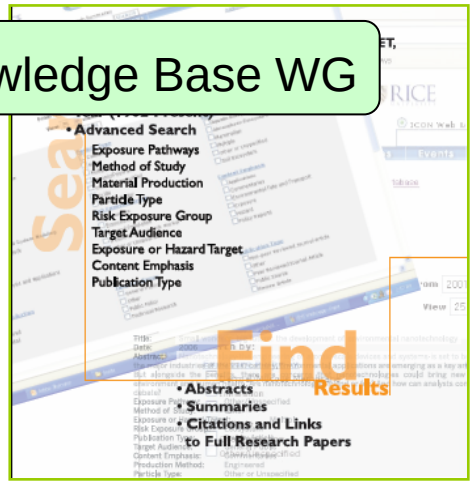
Risk management for nanomaterials

E56 Committee on Nanotechnology

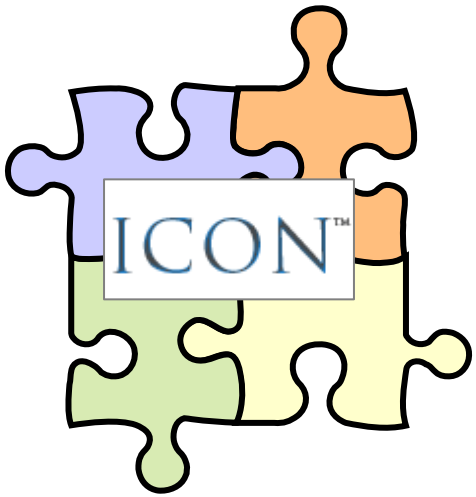
- E56.01 Terminology & Nomenclature* (Colvin sub-chair)
- E56.02 Characterization
- E56.03 Environment, Health, and Safety (Kulinowski sub-chair)
- …

Quality information about risks and benefits

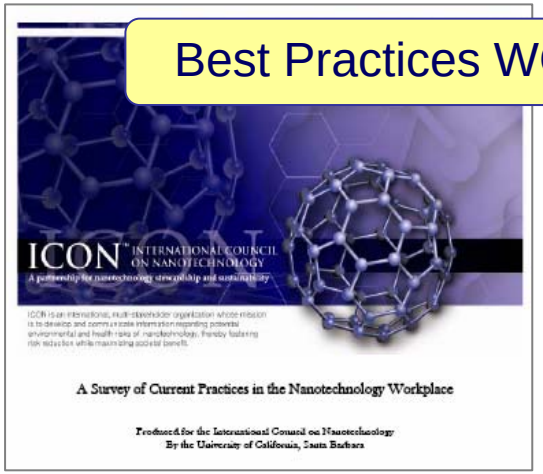
Knowledge Base WG



Database of EHS technical papers



Best Practices WG



Survey of current workplace practices

Communications WG

ICONsultations with diverse stakeholders

CBEN

ICON Working Groups

More information

For more information see our website:

http://cben.rice.edu

http://icon.rice.edu

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