Policy Recommendations for Addressing Potential Health Risks from Nanomaterials

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Project background and process

Report can be found at:
http://prhe.ucsf.edu/prhe/nanomaterialsreport.html

Cal EPA OEHHA requested information → UCSF formed Science Advisory Panel → Regular meetings with SAP to formulate outline → Write chapters and receive comment from SAP → Prepared Draft document, received public comment May 5th 2010

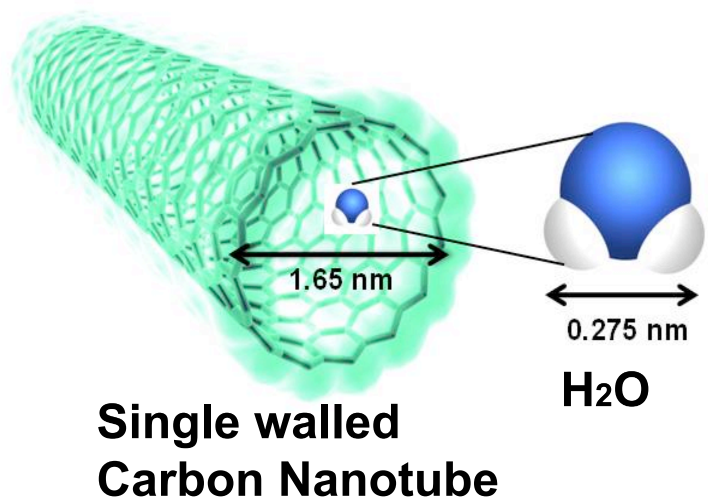
- **Carl Cranor**, UC-Riverside
- **Tejal Desai**, UC- San Francisco
- **Kevin Dreher**, NHEERL, EPA
- **John Froines**, UC-Los Angeles
- **Rebecca Klaper**, Univ. of Wisc. Milwaukee
- **Maria Powell**, Madison Environmental Justice Organization
- **Andrew Maynard**, Project on Emerging Nanotechnologies & Univ. of Michigan
- **Jennifer Sass,** Natural Resources Defense Council
- **David Warheit**, Dupont-Haskell

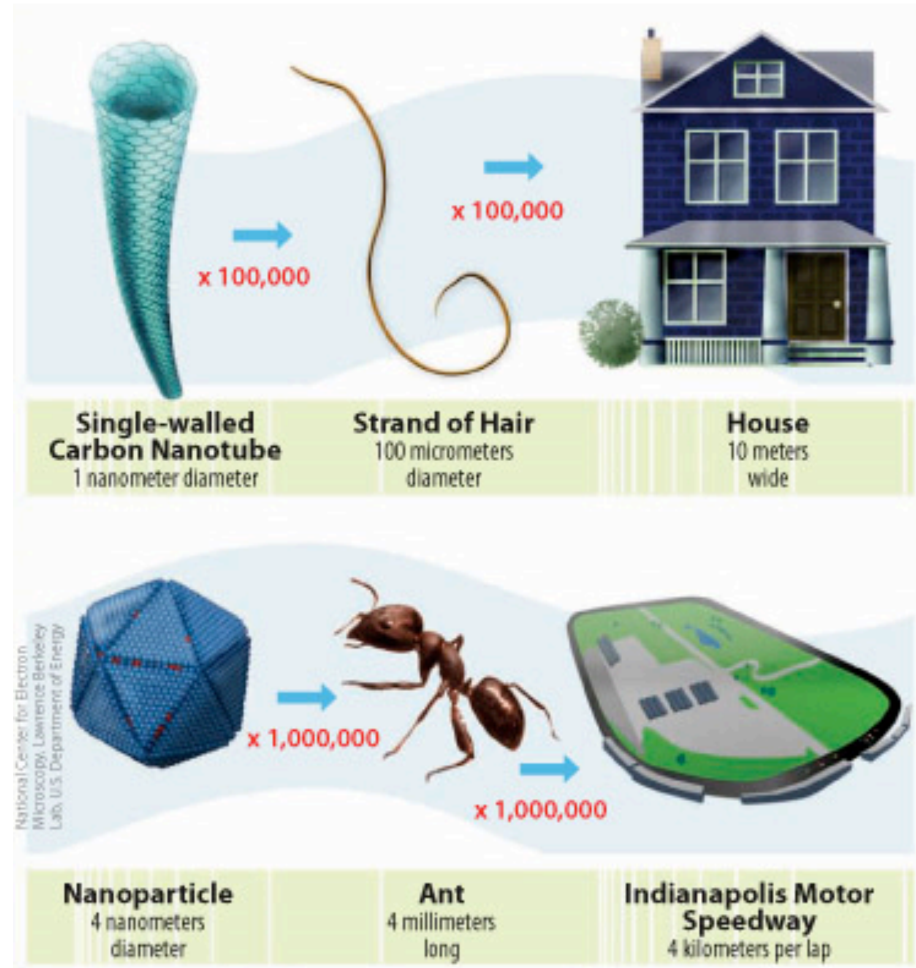
Summary of goals and document

- Introduction to Nanomaterials (Chapter 1)
- Draw upon past lessons from chemical policy experience to inform future decisions (Chapter 2)
- Review toxicity data (Chapter 3)
  - Determine if nanomaterials pose a risk to human health or environment
  - Assess if there are properties specific to nanomaterials that might affect toxicity
- (Chapter 4) Provide *general* recommendations to address policy considerations
- (Ch. 4) Provide *specific* recommendations for health risk related policy options for OEHHA

→Comments are being reviewed, document updated accordingly and finalized.

“Nano-sized”

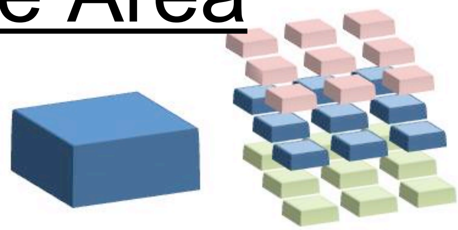




Larger than molecules, smaller than biological cells, similar to organelles (i.e. DNA, proteins)

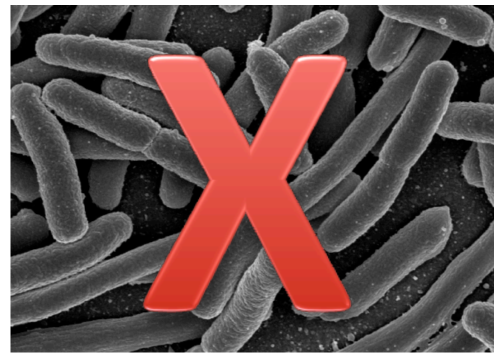
Unique properties

Surface Area

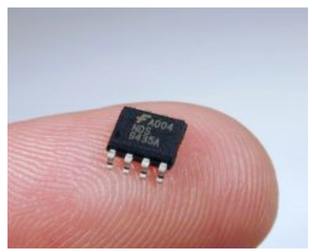


Side length (per cube)	3	1
Volume	27	27
Surface Area	54	164

Anti-microbial

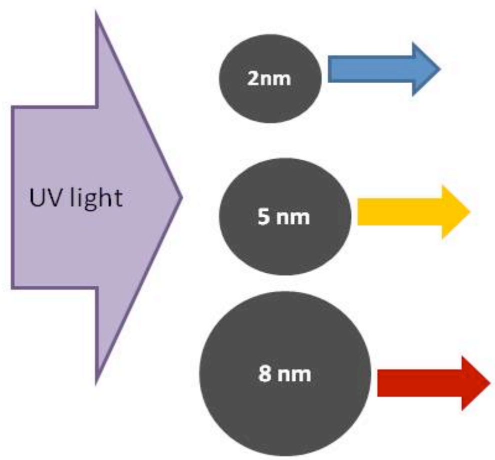


Electronic



Material strength

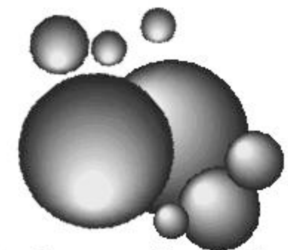
Optical properties



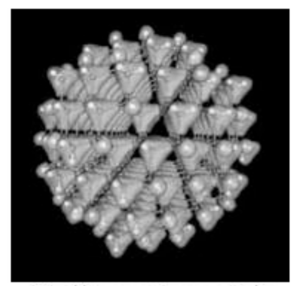
Types of nanomaterials

- Carbon
  - Fullerenes
  - Tubes
    - Single or multi-walled
- Metal
  - Atomic: gold, silver
  - Metal oxides- ZnO, TiO_2, CeO_x, Fe_2O_3
- Composite
  - Quantum dots: heavy metals and metal salts
- Dendrimers
  - Various materials, polymeric structures

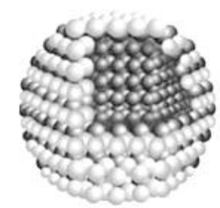
Carbon fullerene "buckyball"
Often 60 atoms (C_{60})
1-5 nm



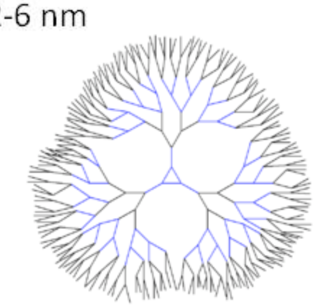
Titanium or silicon dioxide nanoparticles
Often very polydisperse in size ~1-~200 nm



Gallium Arsenide quantum dot
465 atoms, 2-6 nm



Core-shell quantum dot.
<1000 atoms, 2-10 nm

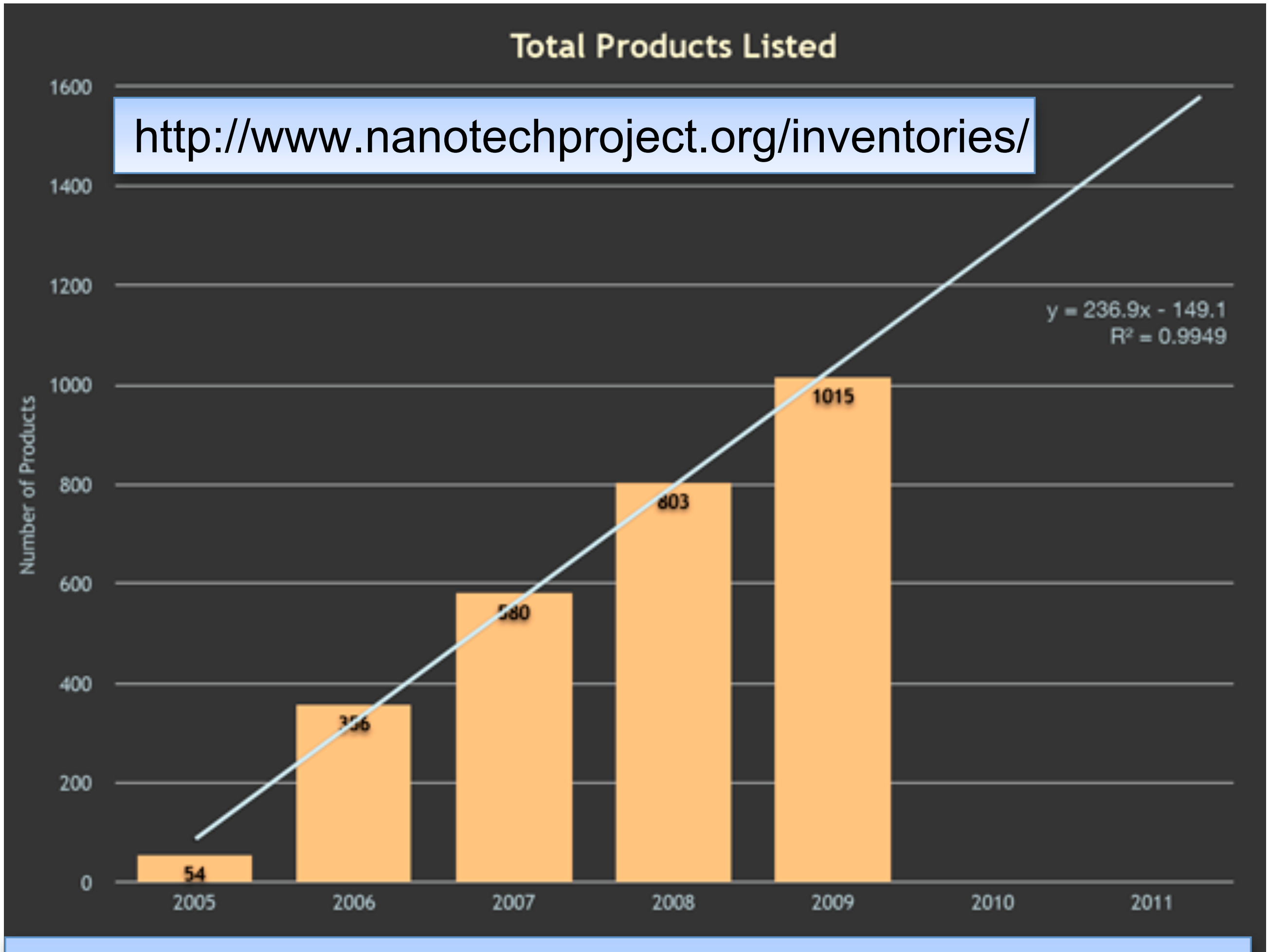


Dendrimer
5-100's nm

images From US EPA Nanotechnology White Paper

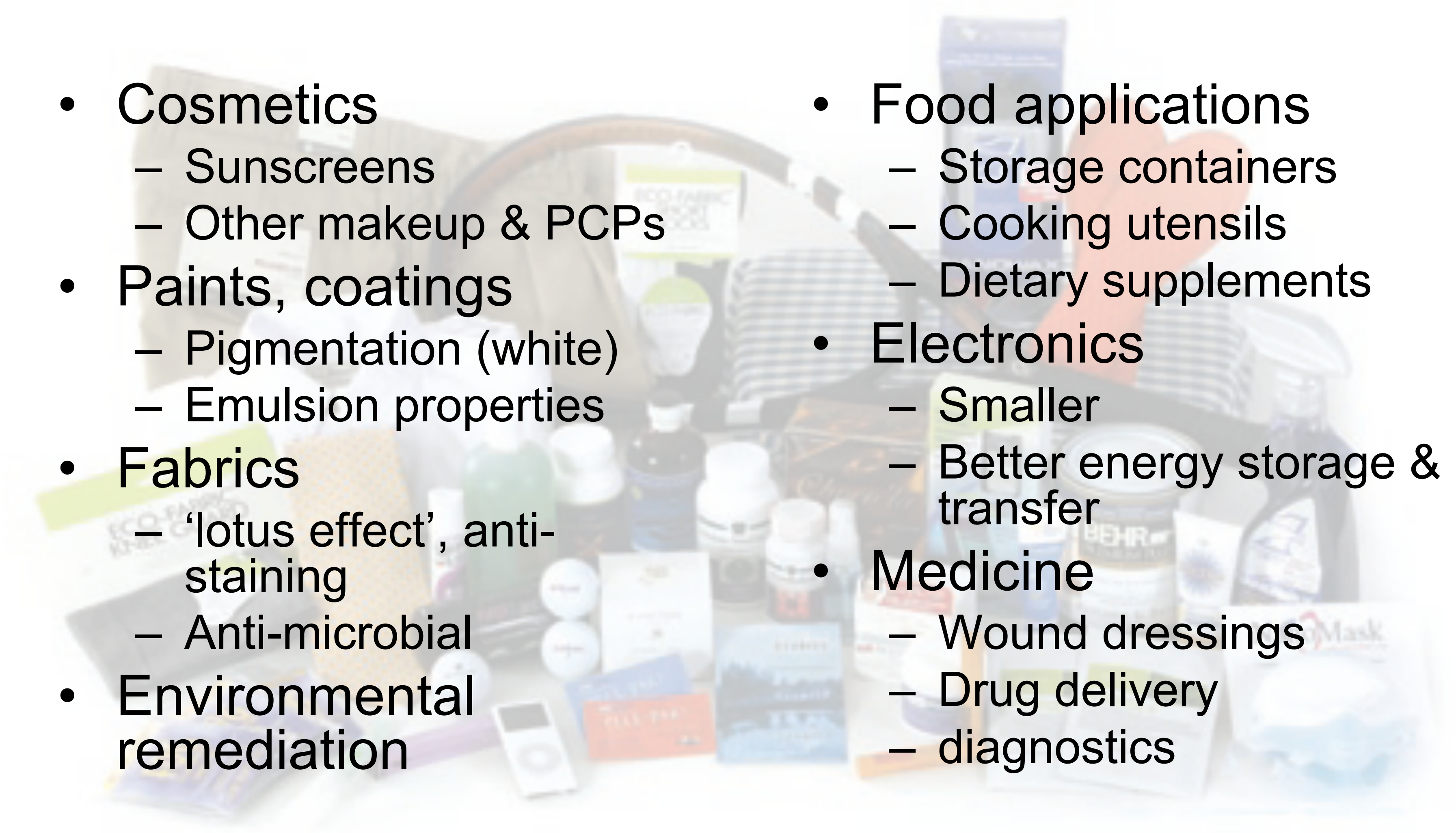
Nanomaterials' use in products

Nanomaterials are NOT a separate sector, but a tool to enable many products and applications



PEN inventory focuses on *consumer products*.
Other sectors include coatings, catalysts, material fillers, etc.

Various nano-enabled products



- Cosmetics
  - Sunscreens
  - Other makeup & PCPs
- Paints, coatings
  - Pigmentation (white)
  - Emulsion properties
- Fabrics
  - ‘lotus effect’, anti-staining
  - Anti-microbial
- Environmental remediation
- Food applications
  - Storage containers
  - Cooking utensils
  - Dietary supplements
- Electronics
  - Smaller
  - Better energy storage & transfer
- Medicine
  - Wound dressings
  - Drug delivery
  - diagnostics

Image from Canadian Report, 2008 and David Hawxhurst

General recommendations summary

Hazard ID and exposure potential	1. Develop a description of nanomaterials
	2. Define unique properties and collect this information to be reported
	3. Group nanomaterials by characteristic (i.e. size, surface charge, specific applications)
Identifying sources of nanomaterials	4. Gather information about types of NPs and uses
	5. Require reporting of manufacturing quantities and products, including an inventory or clearinghouse of information
Addressing Exposure	6. Collect information on fate & transport
	7. Decisions should be made with use, exposure and benefit in mind
	8. Require testing for exposure & release potential of NPs
	9. Increase efforts to protect and educate workers, manufacturers, researchers and downstream users of nanomaterials:
Health Effects	10. Use existing hazard traits, toxicological endpoints and health effects to estimate risk
	11. Review current regulatory structure to see if nanomaterials can be incorporated
	12. Targeted research on fate, transport and health effects
	13. Increase communication with governments, manufacturers and researchers
Product testing	14. Require toxicology testing for consumer products (preferably pre-market)
Engaging and informing the public	15. Implement a labeling system
	16. Include the public in decision processes

What can OEHHA do now?

Recommendation for OEHHA	Relevant program or area
Assess if nanomaterials are already covered under existing policy structure and if so, integrate into current protocol.	Ambient Air Quality Standards AB 289 (the ability to require information from manufacturers regarding chemicals of concern.)
Identify if nanosized materials or particles are more toxic than their bulk material. Review and modify risk assessment guidance to account for possible increased risk from particular nanomaterial exposures (utilize an adjustment factor if necessary). Include and account for susceptible sub-populations.	Hot Spots Toxic Air Contaminant Children's Health Initiative Drinking Water Public Health goal Fish intake recommendations Pesticides Biomonitoring
Determine the extent of nanomaterial use in products.	Indoor Air Program Art Hazard Fuel additives
Identify exposure or release profiles for nanomaterials	Indoor Air Program, Drinking Water Public Health goal Pesticides, Fish intake recommendations
Require labeling for nanomaterials that contain known carcinogens or reproductive effects	Prop 65