# Human Exposure to Nanoparticles Released from Consumer Products: Identification of Issues and Research Needs

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**with**

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# Some Considerations

- What are the products in commerce that lead to public contact?
- What are the *Plausible and Meaningful* contacts and exposures?
- What is the frequency and duration of Contact?
- What is the form and particle size of the material at the time of Contact?
- How does one determine the health significance of any exposures and doses received by the population?

# What is Exposure ?

- **"An Event"**
  - **Short, Long, Periodic, Singular**
  - **Individual or Population**

- **Necessary requirement is actual *"Contact"***
  - **Exposure route**

  ***Based upon an***

  - **Exposure pathway**

# What is Exposure ?

- **An Integral over time – short or long – An IMPORTANT VARIABLE THAT NEEDS TO BE EXAMINED FOR CONSUMER PRODUCTS, and then reviewed in context with relevant toxicology and human health outcomes**

$$E = \int_{t_o}^{t_1} C(t)\,dt$$

**$t_o$ = moment of contact**

**$t_1$-$t_o$ = Length of Contact**

**δ = Instantaneous through**

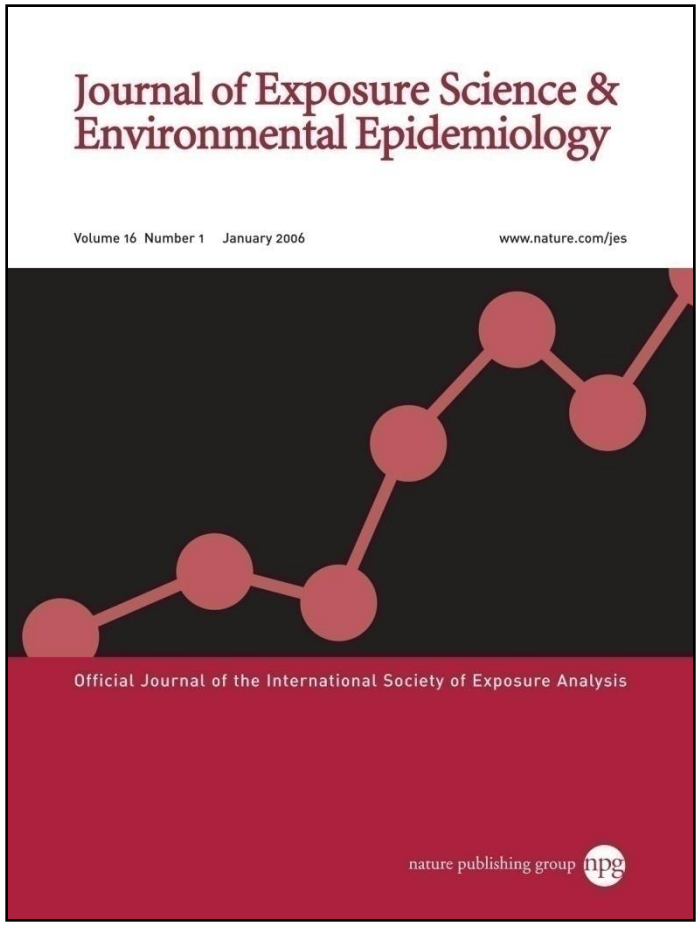
**T = Lifetime**

**Leads to:**

- **A Resulting Dose**

$$D = \int_{t_o} E(t)CR \sim f(x)\,dx\,dt$$

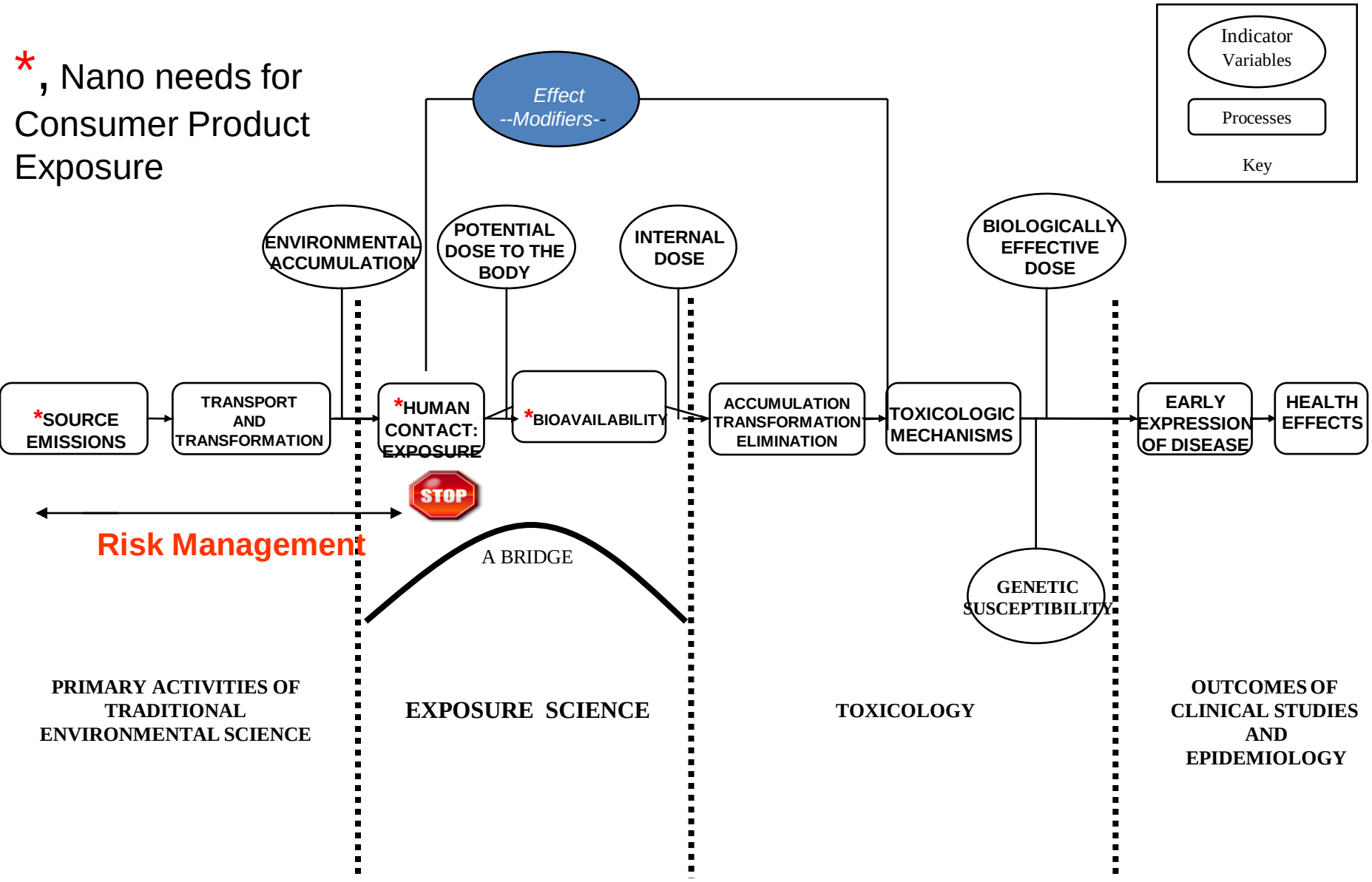
# Definition of Exposure Science - 2006




*Human Exposure Science*: *studies human contact with chemical, physical or biological agents occurring in their environments, and advances knowledge of the mechanisms and dynamics of events either causing or preventing adverse health outcomes.*

# PROCESS CONTINUUM FROM EMISSION OF A CONTAMINANT TO A HEALTH EFFECT AND APPLICATION TO RISK REDUCTION STRATEGIES

*, Nano needs for Consumer Product Exposure




(Adapted from Lioy, 1990 by P. Lioy and A. Roy, Lioy, 1999), Modified February, 2009

# Life Cycle Analysis

- When is it necessary to include exposure?
  - product manufacturing
  - product use
  - activities surrounding the use
  - methods of disposal and recycling
- Previously, have we made mistakes by missing “the exposure” in the life cycle, how to avoid them in the future?
- Need toxicology of product in addition to raw materials for Risk Characterizations

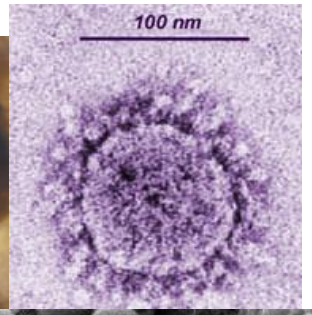
# Areas of concern for Exposure Science and Nanoparticles

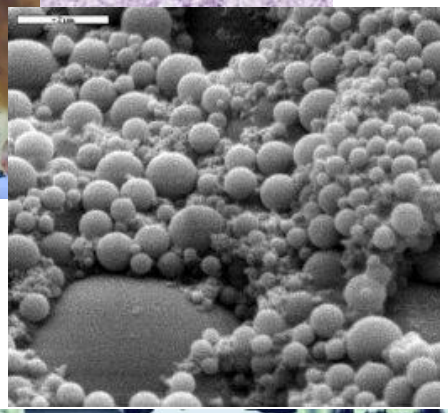
- **Acute Exposure – A lower order issue – Modern US**
  - **Periodic contacts with contaminants**
  - **Accidents**
- **Sub Chronic Exposures**
- **Chronic Exposure – The obsession – Cancer Risk**

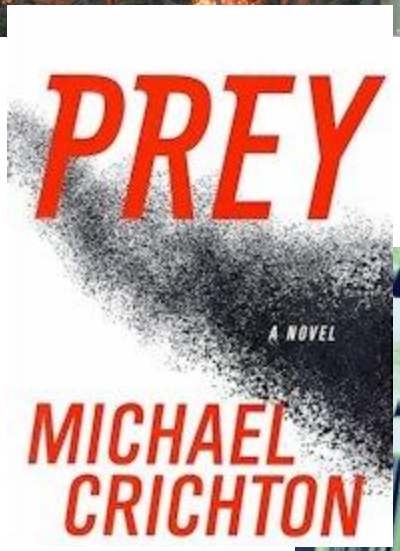
- **Aggregate and Cumulative Exposure – Is that all there is?**
  - **NO**
  - **There are periodic unconnected events**

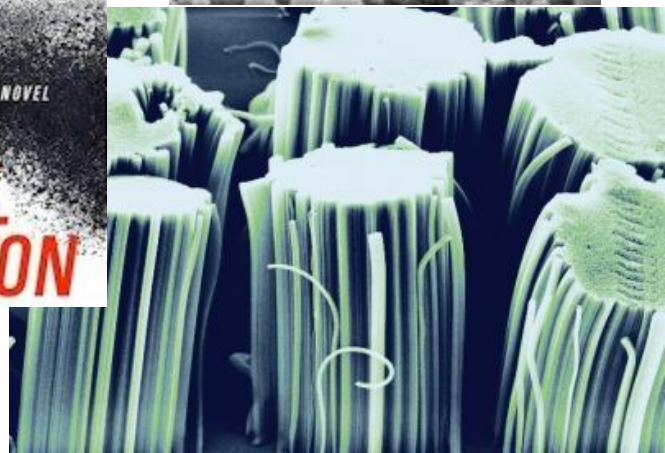
# Nano-sized Particles and Materials

- <100nm in diameter
- Endemic (viruses)
- *Combustion by-products, e.g. diesel exhaust*
- Manufactured particles and structures
- *Larger particles comprised of nano-sized particles*





# Nanoparticles and Nano-sized Materials

- Unique and useful physical, chemical and biological properties due to very large specific surface area and dominance of quantum effects.
- Present in sunscreens, paints, cosmetics, tires, drugs, shampoos, spray cleaners, clothing, etc. – all potentially a source for human “contact”
- Nearly 800 consumer products that utilize nanotechnology, and growing

# ISSUES

- Very little attention to the “potential” engineered nanoparticle release from the consumer products during use
- Airborne exposure is one of the routes that should be investigated for risk characterization and eventual health evaluations, *But*
- *Ingestion and Dermal cannot be ignored*
- Little to no published data on actual human exposure to nanoparticles from consumer products, the issue!

# Types of Products needing Evaluation

- Clothing items with nanotech from different manufacturers
- Sprays and cleaners with nanotech from different manufacturers
- Cosmetics and sunscreens products with nanotech
- Comparisons with similar products without nanotechnology

# Example Hypotheses

- The clothing items that use nanotechnology release higher concentration of airborne nanoparticles than similar non-nanotechnology products. (Inhalation)
- The “wear and tear” on nanotechnology-based clothing increases nanoparticle air emissions and exposure compared releases when “new.” (Inhalation/Ingestion)
- Consumer use of nanotechnology-based sprays results in higher concentrations of airborne nanoparticles (<100 nm in diameter) and exposures compared to similar traditional spray products. (All routes)

We are currently completing preliminary studies on a few

# Source Characterization

- Concern is the commercial or consumer product as a source
- Need information on the size and composition while using the product. *Not manufacturing forms*
- Alterations in form and sizes can occur
  - Coagulation
  - Abrasion

# Exposure Issues

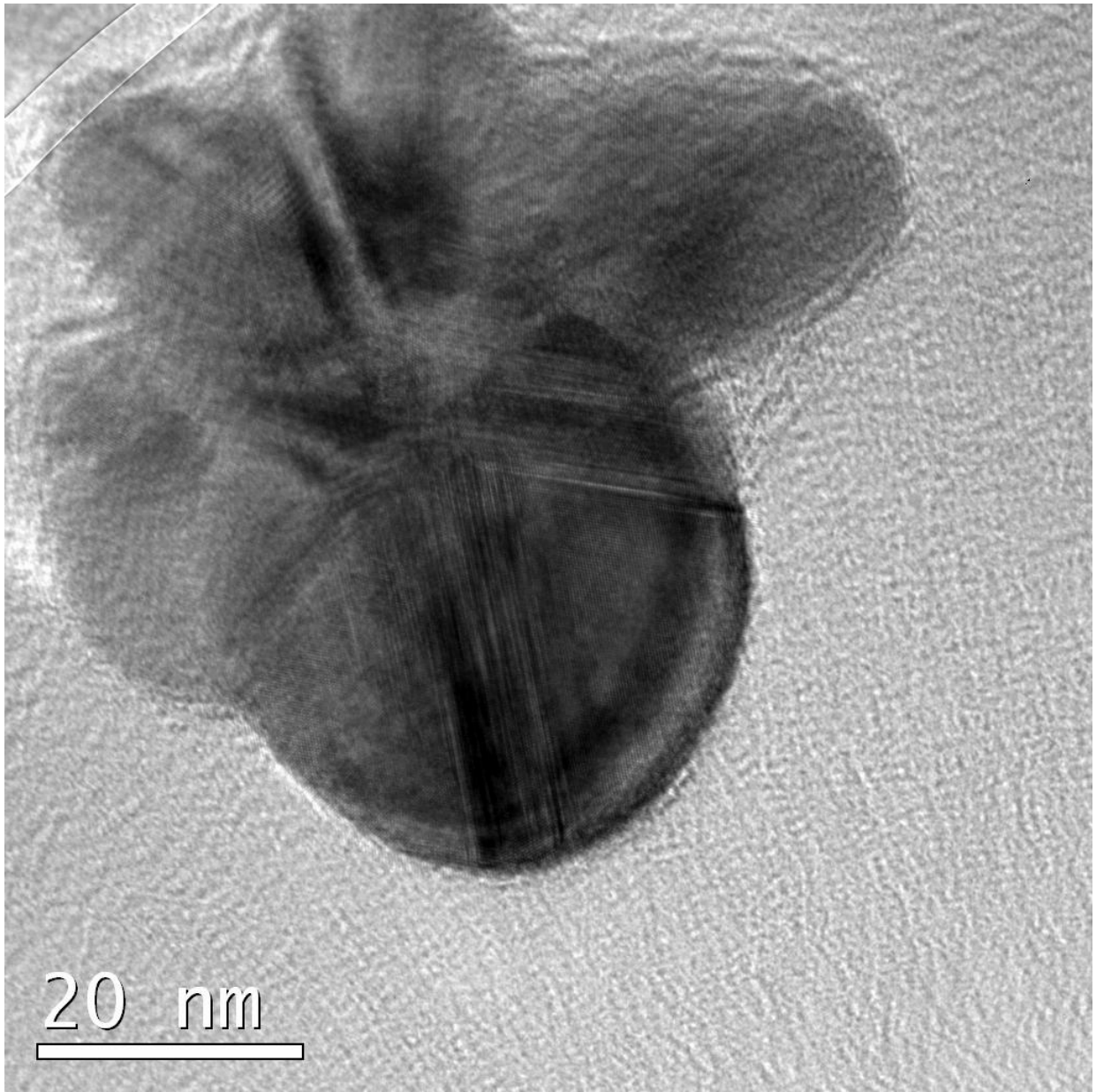
- Direct contact with product emissions during normal use
  - Short term exposures
  - Periodic or repetitive exposures
- Indirect contact with product emissions.
  - Secondary emissions and exposure
    - Physical processes
    - Behaviors and activities

*How much and of what significance to a dose and eventual health considerations?*

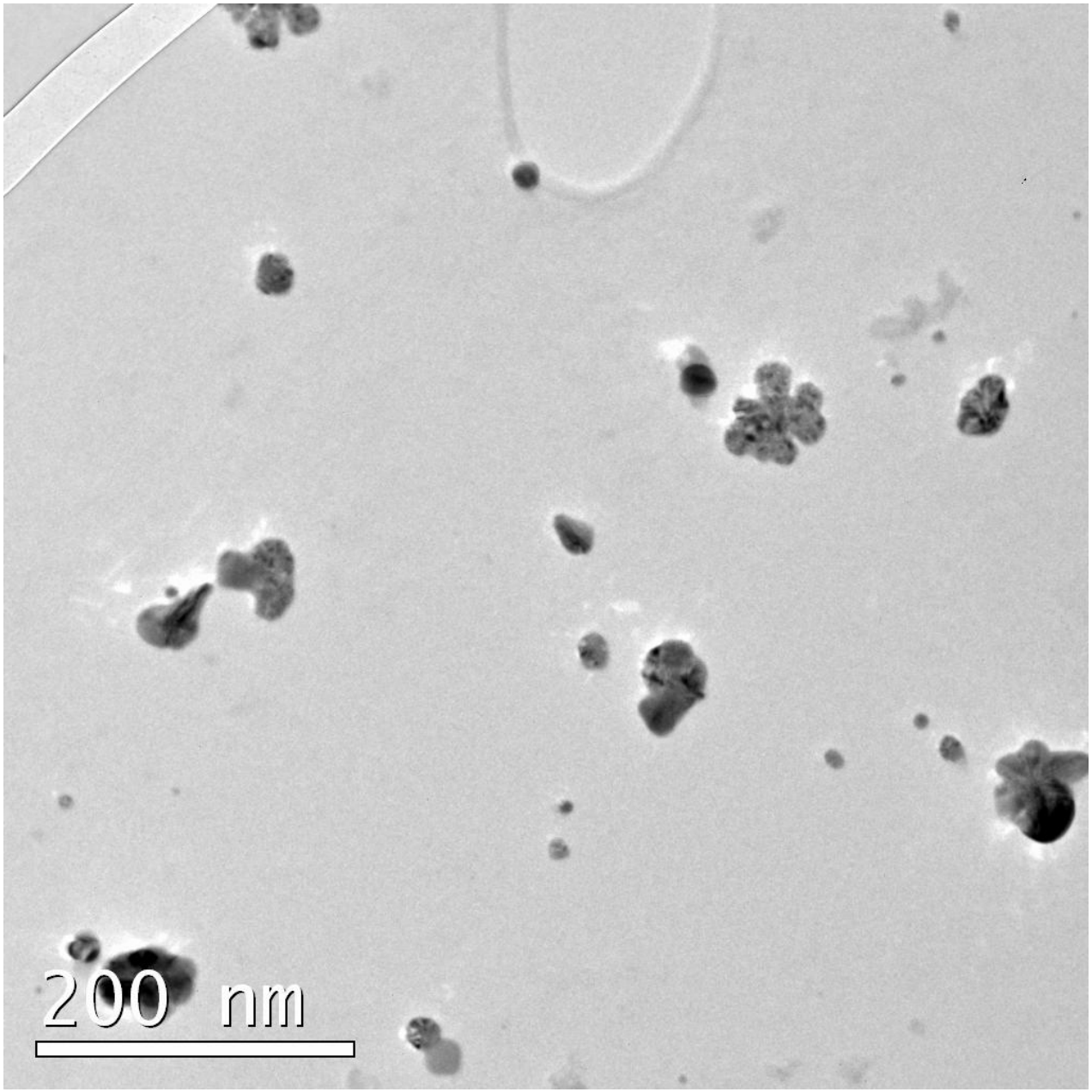
# RESULTS

## Application of Consumer Sprays

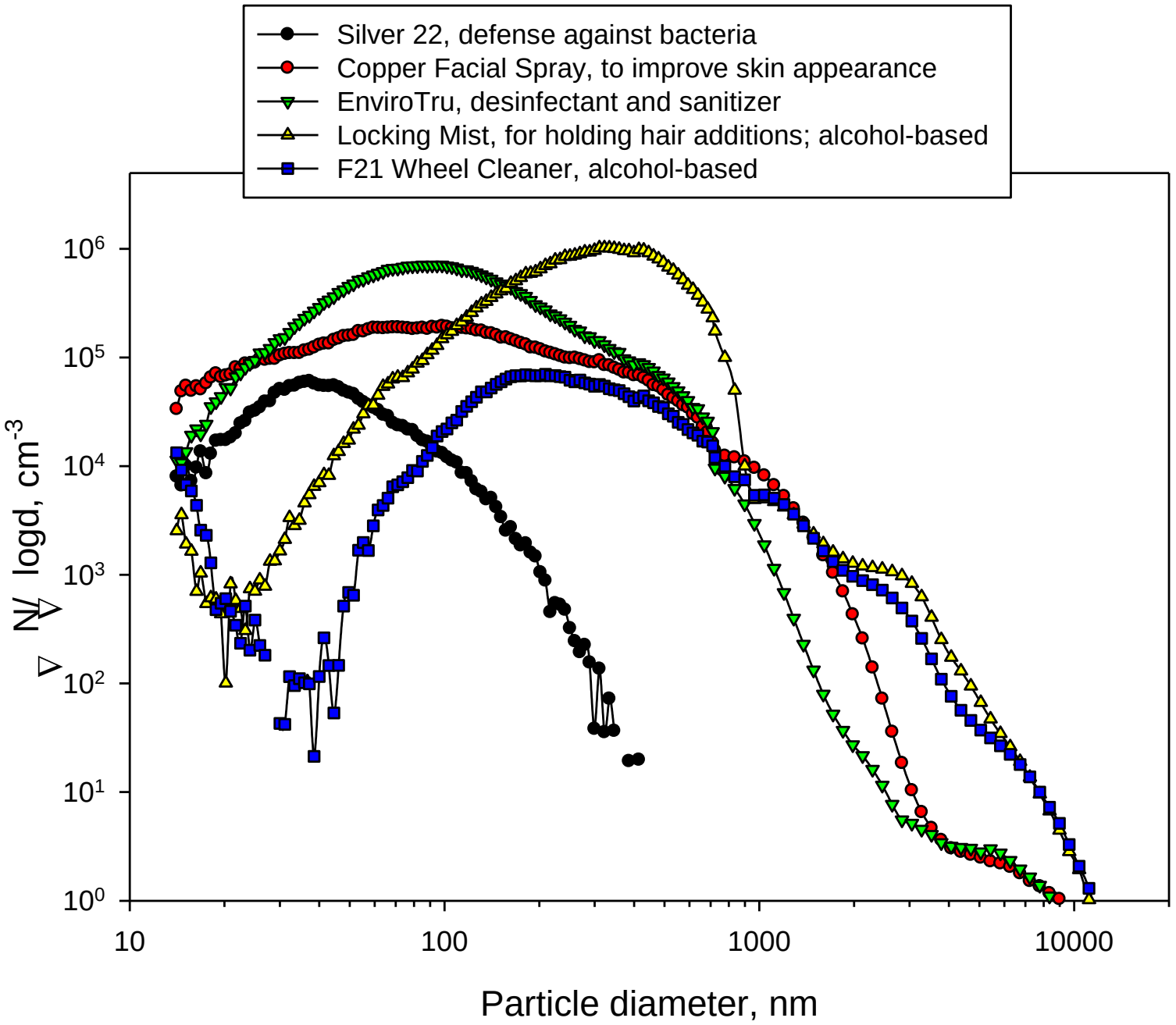
# Nanoceuticals™ Silver 22, skincare supplement



# Nanoceuticals™ Silver 22, skincare supplement



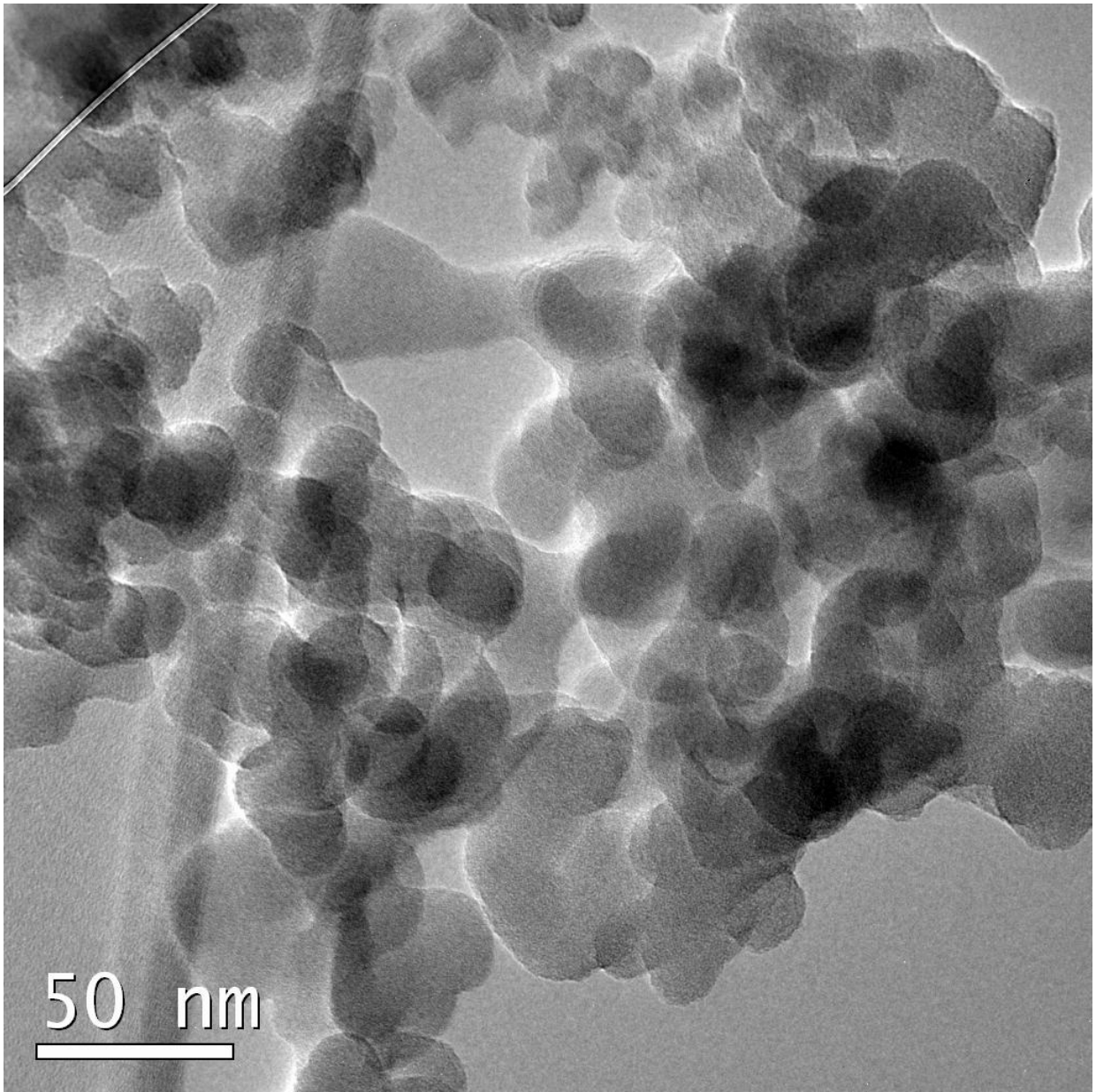
# Size Distribution of Consumer Sprays with Nanotechnology



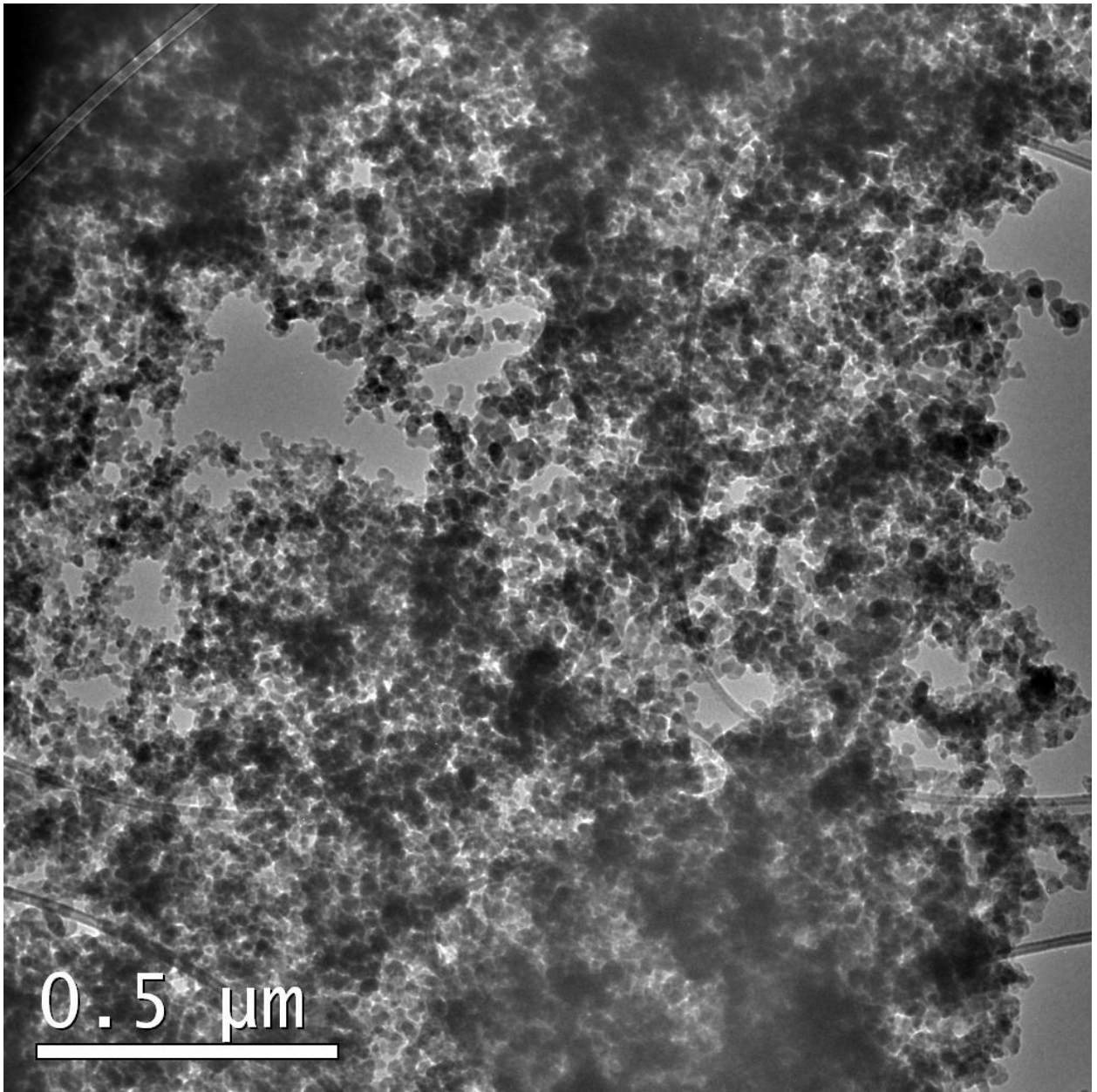
# RESULTS

Application of Cosmetic Products

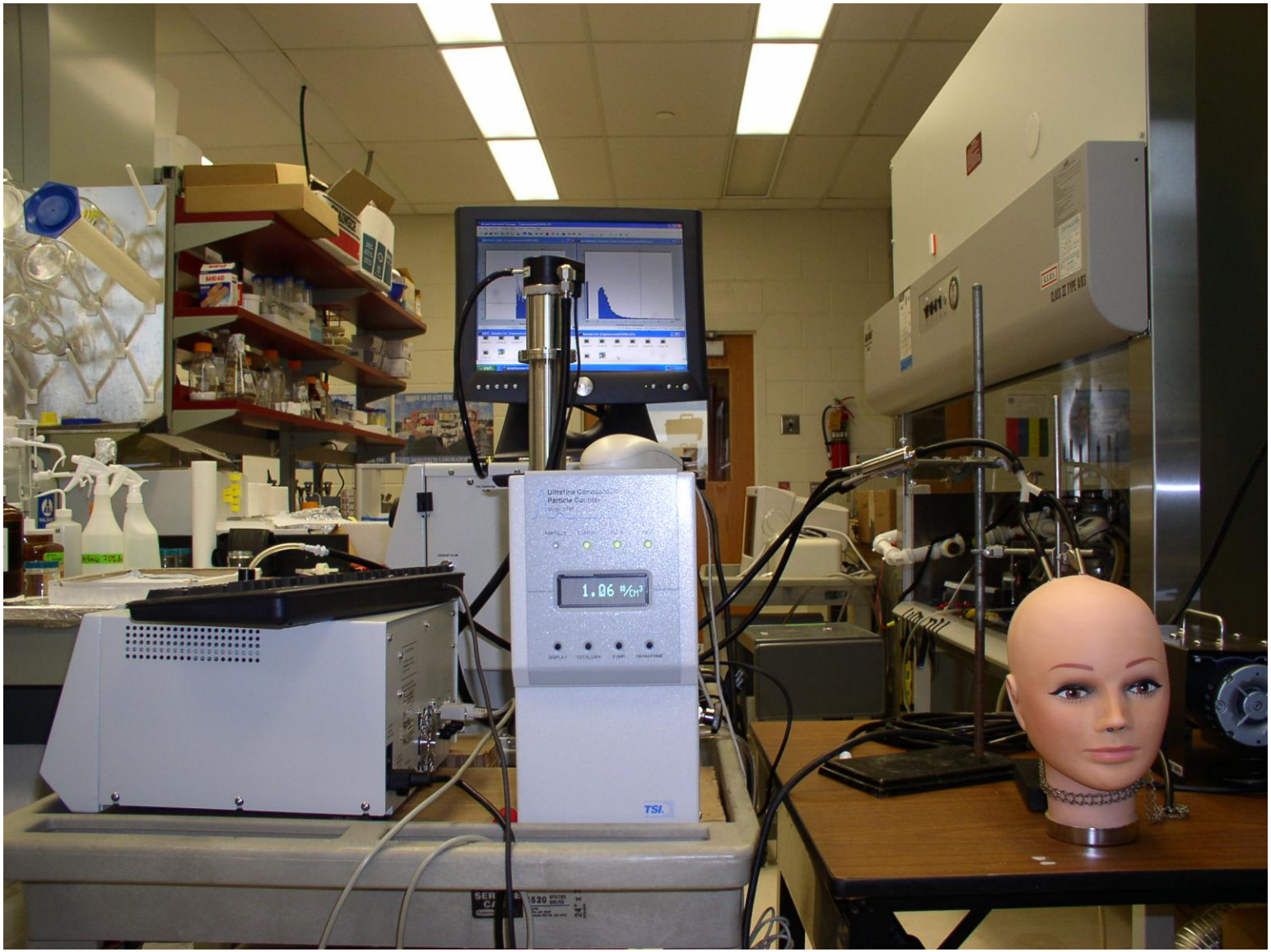
# Faith Cosmetics, Vecteana treatment powder

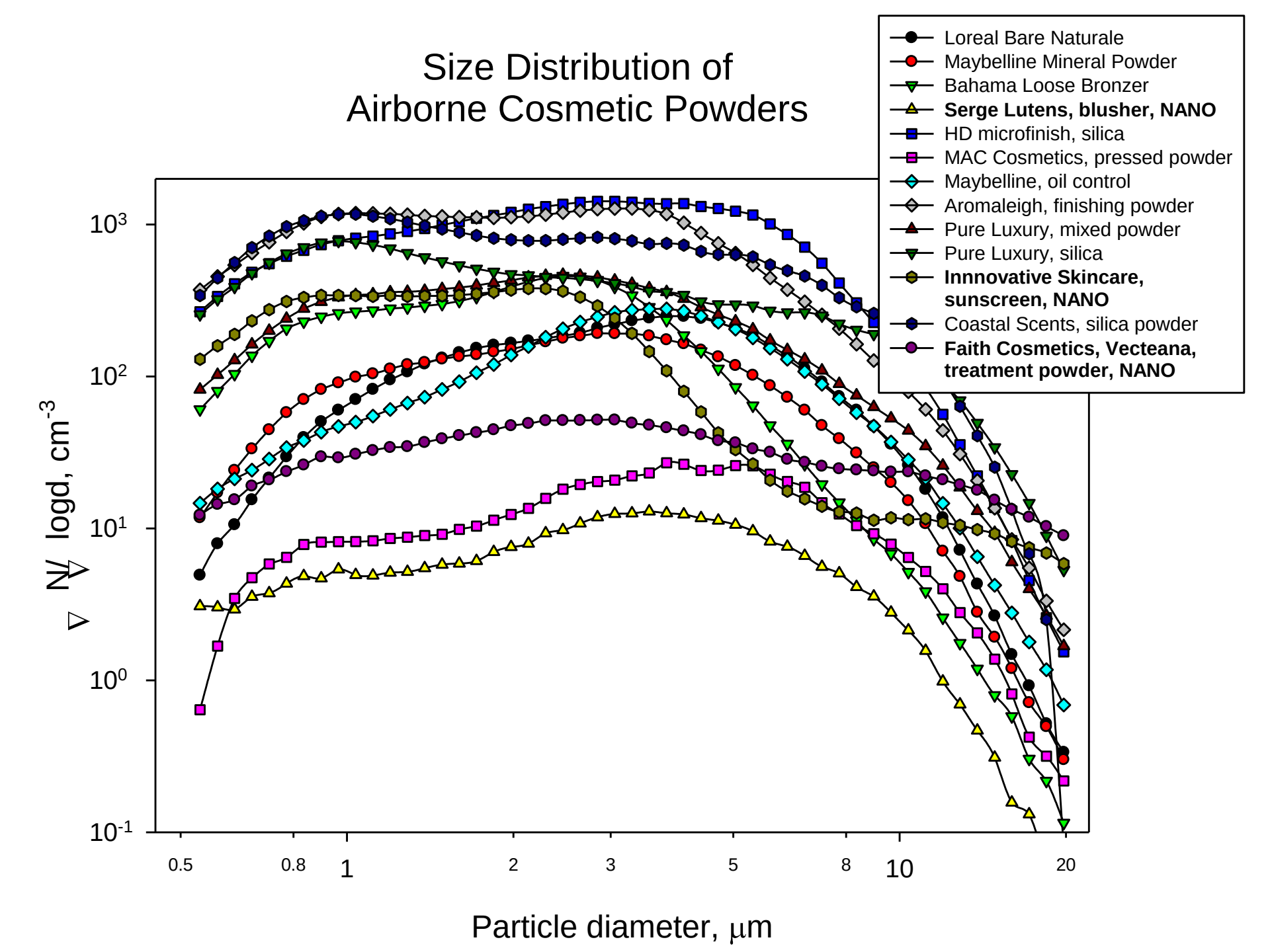


# Faith Cosmetics, Vecteana treatment powder



# Measurement of cosmetic powders' size distribution during application




Size Distribution of
Airborne Cosmetic Powders
Loreal Bare Naturale
Maybelline Mineral Powder
Bahama Loose Bronzer
Serge Lutens, blusher, NANO
HD microfinish, silica
MAC Cosmetics, pressed powder
Maybelline, oil control
Aromaleigh, finishing powder
Pure Luxury, mixed powder
Pure Luxury, silica
Innnovative Skincare, sunscreen, NANO
Coastal Scents, silica powder
Faith Cosmetics, Vecteana, treatment powder, NANO
dN/dlogd, cm-3
10^3
10^2
10^1
10^0
10^-1
0.5
0.8
1
2
3
5
8
10
20
Particle diameter, μm

# Conclusions

- There is a need for further research in each of these and other products and their uses that may be of concern for human exposure
- The data would be used to determine the short-term and long- term dose, and with hazard data lead to a risk assessment for the end use of nanotechnology-based products by the general public.