Research in environment health and safety of nanotechnology and Sustainable Nanotechnology

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US-EU Meeting on NanoEHS

The views presented here are those of the speaker and should not be taken to represent official NSF policy.

The National Science Foundation (NSF) is the primary Federal agency supporting research at the frontiers of knowledge, across all fields of science and engineering (S&E) and all levels of S&E education.

NSF Act of 1950 (Public Law 81-507). The NSF Act set forth a mission: *"to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes."*

The Nano EHS Program (1179)

The environmental Health and Safety of Nanotechnology (Nano EHS) program provides support to examine and mitigate the environmental effects of nanotechnologies. Fundamental research is sought to understand, evaluate, and lessen the impact of nanotechnology on the environmental and biological systems.

The program emphasizes engineering principles underlying the environmental health and safety impacts of nanotechnology. Innovative methods related to clean nanomaterials production processes, waste reduction, recycling, and industrial ecology of nanotechnology are also of interest.

NSF NanoEHS Program Directions

1. Complex and heterogeneous engineered nanomaterials.
The nanomaterials of today and tomorrow are moving from simple, homogeneous, single- element objects to heterogeneous structured materials. Research on the environmental and health implications of these nanomaterials is only in the beginning stages and much work is needed on complex and heterogeneous nanomaterials. NOTE: Proposals addressing silver or gold nanomaterials will be given low priority.

2. Detailed materials characterization.
To get meaningful results in nano EHS studies it is necessary to know what material is being used and what properties of the material might cause the effects on living systems. Characterization is a necessary part of all nanoEHS research.

3. Prevention of adverse impacts.
This is an important research area. It includes both applying environmentally benign synthesis methods in engineering and manufacturing nanomaterials as well using nanotechnology in preventing adverse impacts in current non-nano synthesis and manufacturing processes.

4. Research takes a systems approach.
Whether the impacted system is a natural system or an industrial system, the EHS research must start from a systems view to justify how and where adverse impacts could occur. Research may include models and statistical techniques used to identify priorities for study within systems.

5. Fundamental tools need to be developed.
Monitoring instrumentation, sensors, models, and metrology are but a few of the tools needed for measuring nanomaterials' impact on the environment, health or safety. Fundamental work on standards for measurements are also needed.

6. Nano EHS research informs and enables responsible development and sustainability.
There is a great opportunity for partnership with sustainability programs in the nano EHS area, particularly in applications that improve EHS. For example, nanomaterials and membranes can enhance water treatment or contribute to efficient energy technologies and slow down greenhouse gas production and resource depletion.

NSF Nano EHS types of proposals

A group of 75 from 2013 analyzed

Roughly 4 categories:

Analysis: instrumentation, sensors, modeling, LCA, mathematical methods

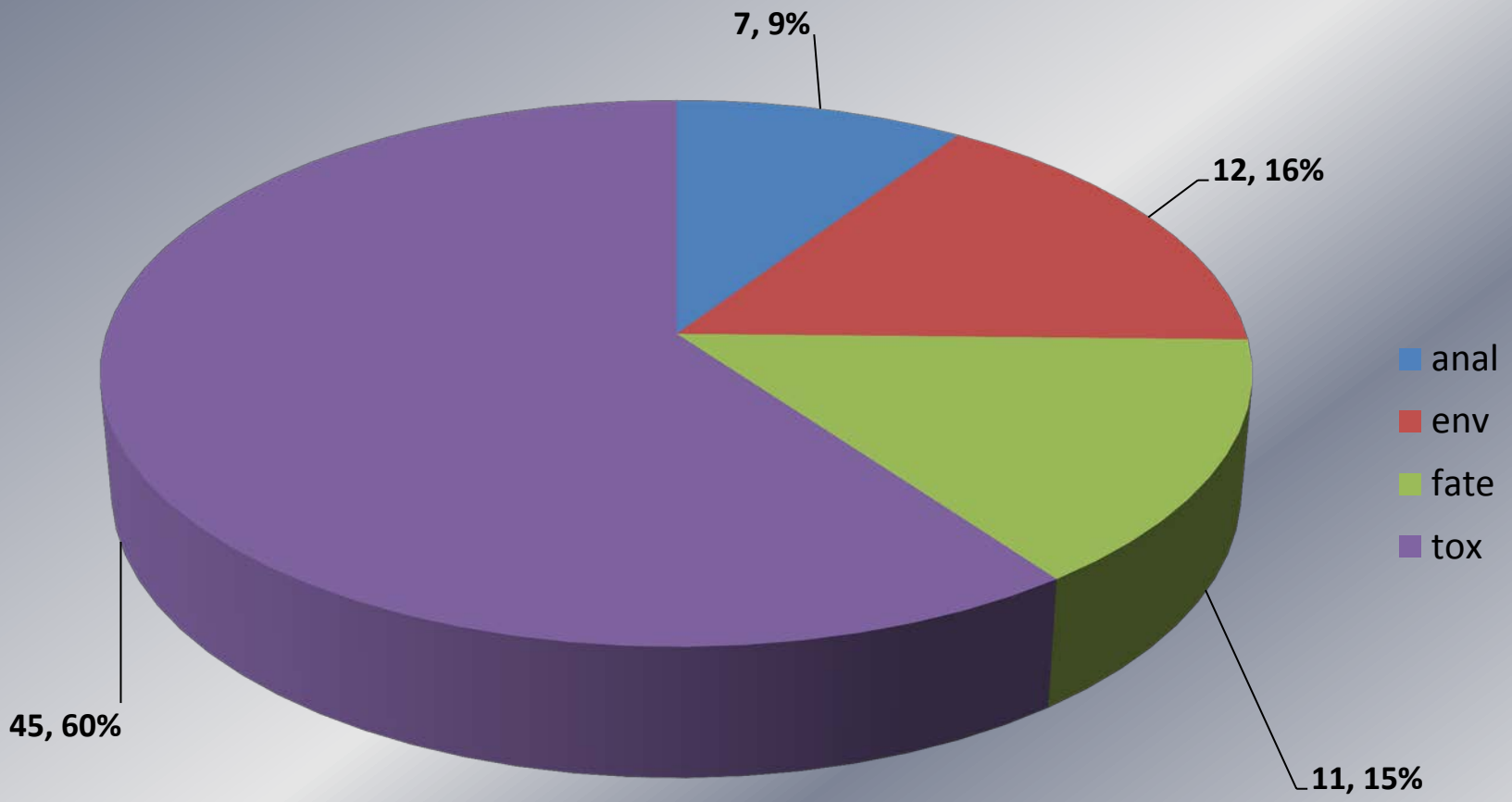
Environmental: nanomaterials interactions in soil, water with organisms or non-living matter

Fate/Transport: Uptake, movements, changes in the environment

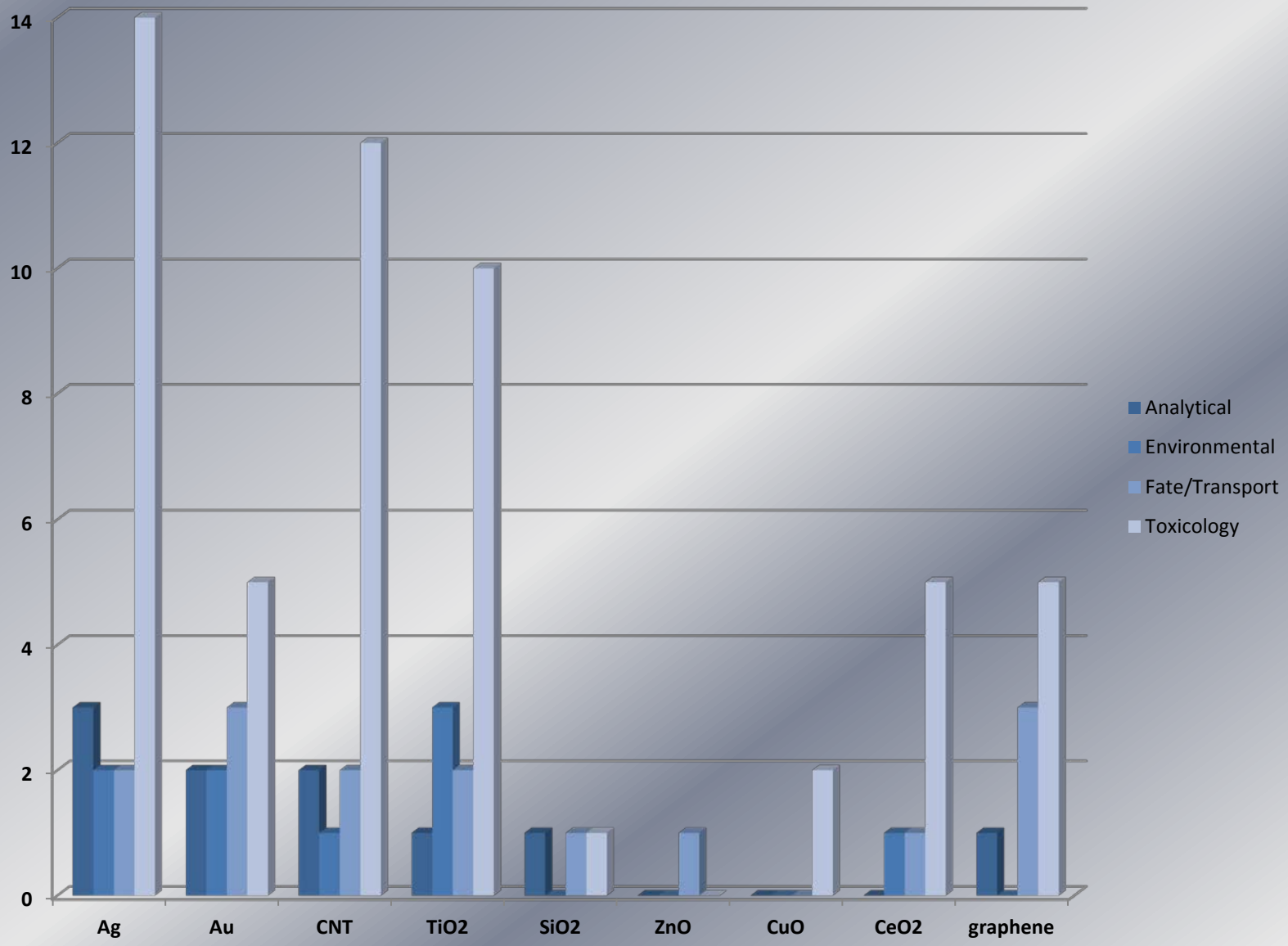
Toxicology: adverse effects of nanomaterials on organisms

Nanomaterials: Ag, Au, CNT, TiO2, ZnO, CeO2, Graphene, QDs, dendrimers, SiO2, ITO, ZVI, C60, PS, HDPE, clay, Fe203, oxides of Ce, In, Nd, Er, Eu, La, zeolites, Cu, CuO

Distribution of categories



Distribution of nanomaterials in categories



Analytical research

Metal fingerprinting and chemothermal isolation methods to quantify natural and engineered carbon nanoparticles

Nanoprospecting: An Approach Towards Environmental Monitoring of Engineered Nanomaterials

GOALI: An Optofluidic Chip for Multiplexed Detection of Heavy Metals

Measuring the Release of Nanoparticles from Polymer Nanocomposites using Single Particle ICPMS and Field Flow Fractionation ICPMS

Environmental/fate/transport

Collaborative Research: Fate, Transport, and Organismal Uptake of Rod-Shaped Nanomaterials

Collaborative Research: Natural Organic Matter, capping agents, and nonoparticle transport in granular media filtration

Toxicology

Assessing the photocatalytic effects of metal-oxide nanoparticles on marine organisms under environmentally-relevant light regimes

Real time quantitative assessment of oxidative stress as a marker for differential nanoparticle toxicity

Understanding the impact of engineered nanoparticles on the lysosome-autophagy system

INSPIRE Track1: Computational Design for the Safe Development of High-Aspect-Ratio Nanomaterials

Sustainable Nanotechnology Organization

Research | Education | Responsibility

3rd Conference
Nov. 2-4, 2014
Boston, Massachusetts

www.susnano.org

The Sustainable Nanotechnology Organization (SNO) is a non-profit, worldwide professional society comprised of individuals and institutions that are engaged in:

- Research and development of sustainable nanotechnology
- Implications of nanotechnology for Environment, Health, and Safety
- Advances in nanoscience, methods, protocols and metrology
- Education and understanding of sustainable nanotechnology
- Applications of nanotechnology for sustainability

SNO's purpose is to provide a professional society forum to advance knowledge in all aspects of sustainable nanotechnology, including environmental applications and implications, societal, and economic components.

SNO current activities:

Conference (Boston, N0v. 2-4, 2014)
Special Workshops
- NanoCeria
- Communicating nanoscience to the public

Publications
- ACS Sustainable Chemistry and Engineering
- RSC Environmental Science: Nano

Industrial Partners
Exhibit
- US Science and Engineering Festival

Special Sessions
- NSTI Nano Meeting

SNO has over 200 members from 5 different countries and from academia, government and industry. About a third of SNO's members are graduate students working on sustainable nanotechnology projects.

www.susnano.org

THANKS!

Questions ?

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"It is not who is right, but what is right that is of importance."
T. Huxley