in Europe was reckoned on the basis of: (a) contribution via release of PAHs to the environment (production and downstream use sites of a category of petroleum products) leading to indirect human exposure in the vicinity of an industrial plant of petroleum products. In this case inhalation becomes the dominant exposure pathway (uptake of 2.1E-01 ng/kg bw/day). (b) contribution via consumer use of a category of petroleum products such as lubricants and coatings in rubber boots. Then, the specific consumer use dominates exposure (uptake rate of 6 ng/kg bw/day). In this case, dermal uptake is the dominant route of exposure followed by oral ingestion.

1699a Health and Environmental Hazard Assessments of Nanomaterials Along Their Lifecycle

A. Erdely[1] and J. Bonner[2]. *[1]NIOSH, Morgantown, WV and [2]North Carolina State University, Raleigh, NC.*

Unprecedented global investment in innovative nanoscale science and engineering has led to the production and utilization of novel materials in expanding fields of electronics, medicine, and composites. Incorporation of advanced materials into existing products through functionalization reactions improves performance, durability, and efficiency in various consumer markets. However, health and environmental hazards of these critical nanomaterials during production, distribution, formulation, use, and disposal have raised concerns. To date, most toxicology research has focused on the as-produced nanomaterial while neglecting the potential health and environmental risks of downstream formulations and applications. This session will highlight 1) exposure potential during production, use, and disposal; 2) hazard identification along the lifecycle of a wide range of nanomaterials; 3) release-testing scenarios with efficacy testing for various nano-enabled products; and 4) the environmental fate of nanomaterials. The outcome of this session will be practical understanding of the most recent research of nanomaterials from a lifecycle perspective. Linking real-world exposures across the lifecycle of nano-enabled products to potential adverse health effects will provide regulators and researchers with essential data needed for effective risk assessment.

1699b Rules and Rates of Release From Nano-Enabled Products: Correlating Aging Conditions, the Properties of Product Matrices, and Nanomaterials

W. Wohlleben. *BASF, Ludwigshafen, Germany.* Sponsor: A. Erdely.

Release assessment regards the detachment of a fragment from a larger whole, such as a consumer product during use, and includes the release mechanism, form of the released entity, release scenario, probability of release, and lifecycle simulation, if relevant. Release assessment is already required in specific legislation. Systematic series of release assessment identify key parameters that enable a ranking (and possibly even a grouping) of the probability and characteristics of release from nano-enabled products: The parameter space is spanned by 1. Chemical aging intensity (photolysis, hydrolysis, leaching) 2. Mechanical shear rates (abrasion, drilling, sanding) 3. matrix properties (soft or brittle, resilient or labile) 4. nanomaterial properties (particulate or fibrous, UV-absorbing, -reactive or -transparent). Based on protocol optimization and inter-laboratory validation by MARINA (FP7), nanoGEM (BMBF) projects, the NanoRelease (US, CAN, EU) initiative, we report on quantitative release rates from real-world value-chains: automotive parts, consumer appliances, and wood coatings. Original data from BASF and the SUN (FP7) project shows that release rates are hierarchically determined in decreasing importance by the above ranking 1 to 4: Many release phenomena are process-dominated with important background of nanoscale releases from conventional materials; accordingly, also the physical-chemical and toxicological properties of fragments released from nano-enabled products resemble primarily those of the matrix, modulated by properties of the nanomaterial. Specifically for weathering, the matrix (various polymers, epoxies, cement) determines releases across 5 orders of magnitude from 100 mg release per MJ of UV energy (cements) down to 0.002 mg/MJ (polyethylenes), with less than a factor of 10 up- or down-modulation by the embedded metal-oxide, carbonaceous, or organic nanomaterials. These values can be directly used for mass-flow modeling of nanomaterial emissions.

1700 Linking Exposures of Particles Released Across Lifecycle of Nano-Enabled Products to Toxicology: An Integrated Methodology for Particle Sampling, Extraction, Dispersion, and Dosing

P. Demokritou. *Harvard School of Public Health, Boston, MA.* Sponsor: A. Erdely.

Nano-enabled products (NEPs) represent a growing economic global market that integrates nanotechnology into our everyday lives. Increased consumer use and disposal of NEPs at their end of life has led to increased environmental, health and safety (EHS) concerns, due to the potential environmental release of constituent engineered nanomaterials (ENMs) used in the synthesis of NEPs. Although, there is an urgent need to assess particulate matter (PM) release scenarios and potential EHS implications, no current standardized methodologies exist across the exposure- toxicological characterization continuum. Here, an integrated methodology will be presented, that can be used to sample, extract, disperse and estimate relevant dose of life cycle released PM (LCPM), for *in vitro* and *in vivo* toxicological studies. The proposed methodology was utilized to evaluate two "real world" LCPM systems: 1) Particles emitted from nano-enabled toners used in laser printers (PEPs); 2) particles released during incineration/thermal decomposition of nano enabled thermoplastics. This comprehensive framework provides a standardized methodology to assess the release and toxicological implications of ENMs released across the life cycle of NEPs and will help in addressing important knowledge gaps in the field of nanotoxicology. More importantly, the LCPM case studies to be presented will provide 1) toxicological evidence for possible deleterious effects of PEPs released during consumer use (printing); 2) shade light on EHS implications at the end of life of NEPs during incineration.

1701 Toxicological Evaluation of Carbon Nanotubes from a Lifecycle Perspective

A. Erdely[1], L. Bishop[1], L. Sargent[1], and J. Bonner[2]. *[1]NIOSH, Morgantown, WV and [2]North Carolina State University, Raleigh, NC.*

In recent years, the unique characteristics of multi-walled carbon nanotubes (MWCNT) have been harnessed to advance material science applications. Unfortunately, those same characteristics may also confer adverse health effects. Companies are actively pursuing avenues which apply a surface coating (e.g. polymer or metals) to as-produced multi-walled carbon nanotubes (MWCNT) in an attempt to enhance functionality, conserve material by facilitating dispersion, and decrease human exposure. Currently, very little is known about the toxicity of these coated materials. MWCNT-enabled products, such as composites, once formed, may then undergo sanding or grinding operations, creating a particulate aerosol of MWCNT and composite matrix with the potential for inhalation exposure. As the process moves from the as-produced MWCNT to manipulation of formed composites, the number of potentially exposed individuals increases, although significant reductions in exposure are predicted from nano-release studies and exposure assessments. Toxicologic and pathologic evaluations showed that in several cases, including aluminum or a proprietary polymer coating, pulmonary inflammation and cytotoxicity were reduced after *in vivo* exposure. In addition, pulmonary fibrosis was significantly reduced as a result of surface coating. *In vitro* genotoxicity screening for micronuclei using a pancentromeric probe to detect loss of whole chromosomes and/or chromosome breakage demonstrated that some industrial coatings reduced the cytotoxicity and genotoxicity of multi-walled carbon nanotubes. These findings enable an efficient and accurate safety profiling of MWCNT of varying characteristics along the lifecycle in conditions representing the greatest risk of inhalation exposure and enhance regulatory decision-making regarding the impact of human exposures.

1702 Quantifying Exposures from Nanotized Products While Assessing Product Efficacy Across Their Value Chain

P. Westerhoff. *Arizona State University, Tempe, AZ.* Sponsor: A. Erdely.

Past and ongoing research shows that enabling products with nanomaterials (NMs) allows less use of organic chemicals or other potential pollutants, because of the improved performance delivered by the NMs. We have developed multiple release testing scenarios that allow us to assess both release of nanomaterials and permits efficacy testing of the consumer product. Examples from two product lines will be discussed: 1) fabrics treated with CNTs for flame retardancy or Ag0 for antimicro-

The Toxicologist

Supplement to *Toxicological Sciences*

55th Annual Meeting and ToxExpo™

SOT

New Orleans, Louisiana

March 13–17, 2016

OXFORD
UNIVERSITY PRESS

ISSN 1096-6080
Volume 150, Issue 1
March 2016

www.toxsci.oxfordjournals.org

The Official Journal of the Society of Toxicology

SOT | Society of Toxicology

Creating a Safer and Healthier World by Advancing the Science and Increasing the Impact of Toxicology

www.toxicology.org

Preface

This issue is devoted to the abstracts of the presentations for the Continuing Education courses and scientific sessions of the 55th Annual Meeting of the Society of Toxicology, held at the New Orleans Ernest N. Morial Convention Center, March 13–17, 2016.

An alphabetical Author Index, cross referencing the corresponding abstract number(s), begins on page 603.

The issue also contains a Keyword Index (by subject or chemical) of all the presentations, beginning on page 629.

The abstracts are reproduced as accepted by the Scientific Program Committee of the Society of Toxicology and appear in numerical sequence. Author names which are underlined in the author block indicate the author is a member of the Society of Toxicology. For example, J. Smith.

Scientific Session Types:

- CE Continuing Education Courses
- EC Education-Career Development Sessions
- FS Featured Sessions
- HH Historical Highlights Sessions
- IS Informational Sessions
- PL Platform Sessions
- PS Poster Sessions
- RI Regional Interest Sessions
- R Roundtable Sessions
- S Symposium Sessions
- W Workshop Sessions

The 2016 SOT Mobile Event App and Online Planner

The Mobile Event App and Online Planner are available via the SOT website and app marketplaces. These mobile tools enable you, the attendee, to engage with organizers, exhibitors, and each other, and to manage your time and maximize your experience during the Annual Meeting. You also can access some ePosters electronically via the Mobile Event App until May 11, 2016.

To cite a 2016 SOT Annual Meeting Abstract, please format as follows: *The Toxicologist*, Supplement to *Toxicological Sciences*, 150 (1), Abstract #__, 2016, Title, First Author.

Copies of *The Toxicologist* are available at $40 each plus shipping ($15 shipping & handling in the USA and $50 for overseas shipments) from:

Society of Toxicology
1821 Michael Faraday Drive, Suite 300 • Reston, VA 20190

www.toxicology.org