

September 1, 2007

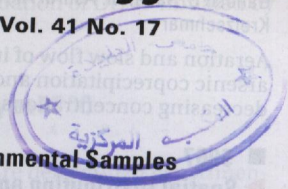
ENVIRONMENTAL Science & Technology

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SEEING CHEMICALS *in* Environmental Samples

Incorporating Risk, Regulation,
and Liability for Carbon Capture
and Sequestration

Particle Emission Characteristics



News and Features

5923 Comment

Citizen science

NEWS

5924 Linking science with new policies for CCS

Policy makers should pay close attention to new research related to this promising, yet still imperfect, technology solution to global climate change.

5925 What to do with greenhouse gases?

While promoting mitigation techniques at a recent meeting, scientists crashed into market barriers.

5925-5929 News Briefs

Access to research for the developing world • Money for climate policy • OSHA must release exposure data • Millions for cellulosic ethanol research • Lessons from Katrina • Asia already hit hard by climate change

5926 Printer particle emissions add up

New findings underscore the effects of indoor air on human health.

5927 Coral, get ready for your close-up

A new tool lets researchers zoom in on coral-reef health.

5928 Rice paddies map arsenic problem

New research clarifies the arsenic problem in Bangladesh, where irrigation water delivers the toxic metal to agricultural soils.

5929 Insect metamorphosis concentrates organic pollutants

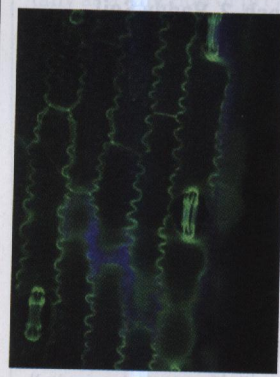
Life-cycle changes lead to higher levels of toxic PBDEs and other compounds in pupae of aquatic insects.

5930 Profile

FEATURE

5934 Seeing Chemicals in Environmental Samples

Edward Wild and Kevin C. Jones



Environmental chemists and toxicologists are frequently interested in *where* an analyte resides within a sample. Are chemicals on surfaces, in matrices, or associated with particular phases or subcellular compartments? Exciting developments in microscopy and imaging are helping to make in situ visualization of chemicals possible. Wild and Jones describe how a new technique called two-photon excitation microscopy coupled with autofluorescence (TPEM-AF) works, and how it can be used to

directly observe the uptake, transport, storage, and degradation of PAHs in the cells and subcellular structures of intact living plants.

Research

POLICY ANALYSIS

■ 5939

China's Growing CO₂ Emissions—A Race between Increasing Consumption and Efficiency Gains

Glen P. Peters, Christopher L. Weber, Dabo Guan, and Klaus Hubacek

China's CO₂ emissions are analyzed, focusing on emissions caused by the production of consumable goods and services and the effects of changes in technology, economic structure, urbanization, and lifestyles.

5945

► Research for Deployment: Incorporating Risk, Regulation, and Liability for Carbon Capture and Sequestration

Elizabeth J. Wilson, S. Julio Friedmann, and Melisa F. Pollak

Before carbon capture and sequestration can be widely deployed, significant regulatory and legal questions must be resolved; research efforts must focus on bounding these

■ 5960

► **Spatial Distribution and Temporal Variability of Arsenic in Irrigated Rice Fields in Bangladesh. 1. Irrigation Water**

Linda C. Roberts, Stephan J. Hug, Jessica Dittmar, Andreas Voegelin, Ganesh C. Saha, M. Ashraf Ali, A. Borhan M. Badruzzaman, and Ruben Kretzschmar

Aeration and slow flow of initially anoxic groundwater leads to arsenic coprecipitation and sorption to soil, thus resulting in decreasing concentrations with distance from field inlets.

■ 5967

► **Spatial Distribution and Temporal Variability of Arsenic in Irrigated Rice Fields in Bangladesh. 2. Paddy Soil**

Jessica Dittmar, Andreas Voegelin, Linda C. Roberts, Stephan J. Hug, Ganesh C. Saha, M. Ashraf Ali, A. Borhan M. Badruzzaman, and Ruben Kretzschmar

Irrigation with As-rich groundwater results in spatially heterogeneous As accumulation in paddy rice soils; this accumulation is partly counteracted by As leaching during monsoon flooding.

■ 5973

Heavy Metals and Stable Isotopes in a Benthic Omnivore in a Trophic Gradient of Lakes

Per Larsson, Niklas Holmqvist, Patrik Stenroth, Olof Berglund, Per Nyström, and Wilhelm Granéli

The nutrient status of lakes influences concentrations of heavy metals, such as Hg and Cd, in benthic omnivorous crayfish.

5980

Body Burdens of Persistent Halogenated Compounds during Different Development Stages of Anadromous Brown Trout (*Salmo trutta*)

Tore C. Svendsen, Katrin Vorkamp, Marie Frederiksen, Bent Rønsholdt, and Jens-Ole Frier

Life-cycle analysis of PBDE, PCB, and DDT in anadromous brown trout shows decoupling between persistent halogenated compounds and lipids during egg production.

■ 5986

Time Trends of Arctic Contamination in Relation to Emission History and Chemical Persistence and Partitioning Properties

Todd Gouin and Frank Wania

Highly persistent organic pollutants partitioning into the world's oceans are most likely to experience a long lag time between emission reductions and Arctic concentration declines.

■ 5993

Speciation of ¹²⁹I and ¹²⁷I in Seawater and Implications for Sources and Transport Pathways in the North Sea

■ 6007

Riverine Inputs of Polybrominated Diphenyl Ethers from the Pearl River Delta (China) to the Coastal Ocean

Yu-Feng Guan, Ji-Zhong Wang, Hong-Gang Ni, Xiao-Jun Luo, Bi-Xian Mai, and Eddy Y. Zeng

Riverine inputs of PBDEs from the Pearl River delta (China) to the coastal ocean are measured.

6014

Dechlorane Plus and Other Flame Retardants in a Sediment Core from Lake Ontario

Xinghua Qiu, Chris H. Marvin, and Ronald A. Hites

The concentration of Dechlorane Plus, a highly chlorinated flame retardant, exceeds those of brominated flame retardants in Lake Ontario sediment.

■ 6020

Pesticides in Western Canadian Mountain Air and Soil

Gillian L. Daly, Ying D. Lei, Camilla Teixeira, Derek C. G. Muir, and Frank Wania

Whereas air concentrations of organochlorine pesticides vary little along and between different mountain slopes, soil concentrations are determined by wet-deposition rates and the retentive capacity of the soil.

■ 6026

Effect of Municipal Sewage Treatment Plant Effluent on Bioaccumulation of Polychlorinated Biphenyls and Polybrominated Diphenyl Ethers in the Recipient Water

Yawei Wang, Xuemei Li, An Li, Thanh Wang, Qinghua Zhang, Pu Wang, Jianjie Fu, and Guibin Jiang

Bioaccumulation of PBDEs and PCBs is found in aquatic species, but biomagnification is not obvious in an aquatic system that receives effluents from a large sewage plant.

ENVIRONMENTAL PROCESSES

6033

Adsorption of Phenanthrene on Natural Snow

Florent Domine, Alessandra Cincinelli, Elodie Bonnaud, Tania Martellini, and Sylvain Picaut

Natural snow is exposed to phenanthrene vapors, and both physical and chemical measurements are performed to test whether phenanthrene is adsorbed onto snow crystals.

6039

► **Particle Emission Characteristics of Office Printers**

Congrong He, Lidia Morawska, and Len Taplin

Some printers emit high levels of particles, whereas others do not; printer model and age and cartridge model and age may affect the particle emission process.

■ 6046

Pinene Oxidation in the Presence of Seed Aerosol:

Pinene Oxidation in the Presence of Seed Aerosol: Growth Rates and Yield

■ 6059

Formation of *N*-Nitrosodimethylamine (NDMA) from Humic Substances in Natural Water

Zhuo Chen and Richard L. Valentine

The NDMA formation potential of solutions containing various humic fractions obtained from a surface water indicates that precursor substances are distributed in all fractions; this suggests either the nonspecificity of the fractionation procedure with respect to discrete precursors or that humic substances represent a nonspecific source of precursor material.

6066

Inhibition of Humic Substances Mediated Photooxygenation of Furfuryl Alcohol by 2,4,6-Trimethylphenol. Evidence for Reactivity of the Phenol with Humic Triplet Excited States

Sabrina Halladja, Alexandra ter Halle, Jean-Pierre Aguer, Abdelaziz Boulkamh, and Claire Richard

The competition technique is used to demonstrate that triplet excited states of humic substances react directly with 2,4,6-trimethylphenol and that the same triplets are responsible for producing singlet oxygen and oxidizing this phenol.

■ 6074

Regulated and Non-Regulated Emissions from In-Use Diesel-Electric Switching Locomotives

Aniket A. Sawant, Abhilash Nigam, J. Wayne Miller, Kent C. Johnson, and David R. Cocker, III

Detailed chemical characterization of gaseous (NO_x , CO, THC, carbonyl) and particulate (PM, EC, OC, PAH) emissions from three in-use diesel-electric switching locomotives is presented.

■ 6084

Control of Ferrous Iron Oxidation within Circumneutral Microbial Iron Mats by Cellular Activity and Autocatalysis

Jeremy A. Rentz, Charoenkwan Kraiya, George W. Luther, III, and David Emerson

The metabolic activity of microbes and surface-mediated oxidation both contribute significantly to the overall oxidation of ferrous iron in circumneutral microbial iron mats.

6090

Incidence of the Enterococcal Surface Protein (*esp*) Gene in Human and Animal Fecal Sources

Richard L. Whitman, Katarzyna Przybyla-Kelly, Dawn A. Shively, and Muruleedhara N. Byappanahalli

The proposed and increasingly used sewage marker, the *esp* gene in enterococci, is found in both human and animal fecal sources.

■ 6096

Effect of Ammonia on Secondary Organic Aerosol Formation from α -Pinene Ozonolysis in Dry and Humid

6109

Mechanism of OH-Initiated Atmospheric Photooxidation of Dichlorvos: A Quantum Mechanical Study

Qingzhu Zhang, Xiaohui Qu, and Wenxing Wang

A theoretical study indicates that four product pathways are energetically feasible for the degradation of DDVP initiated by OH radicals in the atmosphere.

■ 6117

Iron(III) Hydrolysis and Solubility at 25 °C

Andri Stefánsson

Iron(III) hydrolysis and solubility are determined experimentally as a function of pH at 25 °C.

6124

Enantioselectivity in Estrogenic Potential and Uptake of Bifenthrin

Lumei Wang, Weiping Liu, Caixia Yang, Zhiyan Pan, Jianying Gan, Chao Xu, Meirong Zhao, and Daniel Schlenk

This study demonstrates significant enantioselectivity in the uptake of bifenthrin and its ability to cause estrogenic effects in vivo and in vitro.

■ 6129

Oligomers in the Early Stage of Biogenic Secondary Organic Aerosol Formation and Growth

Katherine J. Heaton, Matthew A. Dreyfus, Shenyi Wang, and Murray V. Johnston

When monoterpenes react with ozone to produce SOA, oligomers composed mainly of organic peroxides are produced very quickly—within a few seconds of the reaction.

■ 6137

Concentration Changes of Organochlorine Compounds and Polybromodiphenyl Ethers during Metamorphosis of Aquatic Insects

Mireia Bartrons, Joan O. Grimalt, and Jordi Catalan

An enrichment of OCs and PBDEs from larvae to pupae in aquatic insects may result in a 2–5-fold higher pollutant intake for predators.

■ 6142

U(VI)-Kaolinite Surface Complexation in Absence and Presence of Humic Acid Studied by TRLFS

Adéla Kepelová, Vinzenz Brendler, Susanne Sachs, Nils Baumann, and Gert Bernhard

TRLFS is used to characterize the U(VI) surface species on kaolinite in the absence and presence of HA.

■ 6148

Enhanced Diffusion of Polycyclic Aromatic Hydrocarbons in Artificial and Natural Aqueous Solutions

Philipp Mayer, Margit M. Fernqvist, Peter S. Christensen, Ulrich Karlson, and Stefan Trapp

■ 6163

Chiral Source Apportionment of Polychlorinated Biphenyls to the Hudson River Estuary Atmosphere and Food Web

Brian J. Asher, Charles S. Wong, and Lisa A. Rodenburg

The enantiomeric composition of chiral PCBs is measured to determine the sources of contamination to the Hudson River estuary atmosphere and food web.

■ 6170

Photochemical Attenuation of *N*-Nitrosodimethylamine (NDMA) and other Nitrosamines in Surface Water

Megan H. Plumlee and Martin Reinhard

An aquatic photolysis study of wastewater-derived nitrosamines reports the measured quantum yields and expected photolysis decay rates in engineered and natural systems.

■ 6177

Ozone-Initiated Chemistry in an Occupied Simulated Aircraft Cabin

Charles J. Weschler, Armin Wisthaler, Shannon Cowlin, Gyöngyi Tamas, Peter Ström-Tejsten, Alfred T. Hodgson, Hugo Destailhats, Jason Herrington, Junfeng (Jim) Zhang, and William W. Nazaroff

Ozone reacts with the surfaces of people and their clothing, seats, carpeting, and other materials inside a simulated aircraft cabin to produce a mixture of oxidation products, including saturated and unsaturated aldehydes, ketones, and organic acids.

ENVIRONMENTAL MODELING

■ 6185

Modeling Decreased Food Chain Accumulation of PAHs Due to Strong Sorption to Carbonaceous Materials and Metabolic Transformation

Caroline T. A. Moermond, Theo P. Traas, Ivo Roessink, Karin Veltman, A. Jan Hendriks, and Albert A. Koelmans

BC-inclusive PAH food chain accumulation modeling allows estimation of in situ PAH metabolization rates.

■ 6192

Modeling the Effect of Snow and Ice on the Global Environmental Fate and Long-Range Transport Potential of Semivolatile Organic Compounds

Judith Stocker, Martin Scheringer, Fabio Wegmann, and Konrad Hungerbühler

Snow and ice can strongly influence the environmental partitioning and long-range transport of organic chemicals.

ENVIRONMENTAL MEASUREMENTS METHODS

■ 6199

Evaluation and Comparison of Portable Emissions

Measurement Systems and Federal Reference Methods for

Adsorption of SO₂ by the silica gel tube and subsequent oxidation in the extraction process is the source of artifact sulfate when NIOSH Method 7903 is used.

■ 6210

In Situ Applications of a New Diver-Operated Motorized Microsensor Profiler

Miriam Weber, Paul Faerber, Volker Meyer, Christian Lott, Gabriele Eickert, Katharina E. Fabricius, and Dirk de Beer

A new diver-operated motorized microsensor profiler is described, and three field applications are discussed.

REMEDIATION AND CONTROL TECHNOLOGIES

6216

Manipulating the Size and Dispersibility of Zerovalent Iron Nanoparticles by Use of Carboxymethyl Cellulose Stabilizers

Feng He and Dongye Zhao

The size and dispersibility of zerovalent iron nanoparticles can be controlled by using carboxymethyl cellulose as a stabilizer and by manipulating synthesis conditions.

■ 6222

Degradative Capacities and Bioaugmentation Potential of an Anaerobic Benzene-degrading Bacterium Strain DN11

Yuki Kasai, Yumiko Kodama, Yoh Takahata, Toshihiro Hoaki, and Kazuya Watanabe

A denitrifying bacterium strain DN11 degrades benzene and other monoaromatic compounds under anaerobic conditions and is potentially useful for bioaugmentation of benzene-contaminated underground aquifers.

■ 6228

Unexpected Products and Reaction Mechanisms of the Aqueous Chlorination of Cimetidine

Jeffrey M. Buth, William A. Arnold, and Kristopher McNeill

Substantial structural changes are observed upon chlorination of cimetidine, leading to imidazole and sultam products, two of which have higher predicted toxicity than the parent molecule.

■ 6234

Synergetic Effect of Bi₂WO₆ Photocatalyst with C₆₀ and Enhanced Photoactivity under Visible Irradiation

Shengbao Zhu, Tongguang Xu, Hongbo Fu, Jincui Zhao, and Yongfa Zhu

The use of Bi₂WO₆ is investigated as a plausible strategy to develop an efficient photocatalyst for the destruction of pollutants by using visible light and solar energy.

■ 6240

Highly Efficient Decomposition of Organic Dyes by Aqueous-Fiber Phase Transfer and in Situ Catalytic

Oxidation Using Fiber-Supported Cobalt Phthalocyanine

■ 6253

Partitioning, Desorption, and Dechlorination of a PCB Congener in Sediment Slurry Supernatants

Yuanxiang Fang and Souhail R. Al-Abed

A PCB congener is dechlorinated by Fe/Pd in sediment slurry supernatants, and the processes are modeled to reveal relationships among partitioning, desorption, and dechlorination.

■ 6259

Photoelectrocatalytic Activity of Highly Ordered TiO₂ Nanotube Arrays Electrode for Azo Dye Degradation

Zhonghai Zhang, Yuan Yuan, Guoyue Shi, Yanju Fang, Linhong Liang, Hongchun Ding, and Litong Jin

The photoelectrocatalytic and photocatalytic activities of the electrode are effective for achieving enhanced methyl orange degradation.

■ 6264

In Situ Fenton Reagent Generated from TiO₂/Cu₂O Composite Film: A New Way to Utilize TiO₂ under Visible Light Irradiation

Yong-Gang Zhang, Li-Li Ma, Jia-Lin Li, and Ying Yu

A new method is introduced to use TiO₂ under visible light in the presence of Cu₂O.

6270

The Effects of Intermittent Aeration on the Characteristics of Bio-Cake Layers in a Membrane Bioreactor

Seok-Hwan Hong, Woo-Nyoung Lee, Hyun-Suk Oh, Kyung-Min Yeon, Byung-Kook Hwang, Chung-Hak Lee, In-Soung Chang, and Sangho Lee

An analysis is presented of the temporal change in bio-cake architecture during intermittent aeration in a membrane bioreactor.

6277

Treatment of Perchlorate-Contaminated Groundwater Using Highly Selective, Regenerable Ion-Exchange Technologies

Baohua Gu, Gilbert M. Brown, and Chen-Chou Chiang

A new selective, regenerable ion-exchange technology enables enhanced treatment efficiency, recycling of both resin and regenerant solution, and quantitative destruction or recovery of perchlorate.

SUSTAINABILITY ENGINEERING AND GREEN CHEMISTRY

■ 6283

Silver Emissions and their Environmental Impacts: A Multilevel Assessment

Matthew J. Eckelman and T. E. Graedel

Emissions of silver and their environmental impacts are quantified for 64 countries, eight world regions, and the planet as a whole.

ECOTOXICOLOGY AND HUMAN ENVIRONMENTAL HEALTH

■ 6297

Predicting Bioavailability of Sediment Polycyclic Aromatic Hydrocarbons to *Hyalella azteca* Using Equilibrium Partitioning, Supercritical Fluid Extraction, and Pore Water Concentrations

Steven B. Hawthorne, Nicholas A. Azzolina, Edward F. Neuhauser, and Joseph P. Kreitinger

Sediment toxicity is predicted best from alkyl and parent PAH concentrations in pore water.

■ 6305

Estrogen-Induced Alterations in *amh* and *dmrt1* Expression Signal for Disruption in Male Sexual Development in the Zebrafish

Rüdiger W. Schulz, Jan Bogerd, Rune Male, Jonathan Ball, Martina Fenske, Lisbeth C. Olsen, and Charles R. Tyler

Estrogen-induced alterations in the expression of *amh* and *dmrt1* during early life signal for subsequent disruption of sexual development in male zebrafish.

CORRESPONDENCE AND REBUTTAL

6311

Comment on "Photocatalytic Oxidation of Arsenite on TiO₂: Understanding the Controversial Oxidation Mechanism Involving Superoxides and the Effect of Alternative Electron Acceptors"

W. H. Leng, X. F. Cheng, J. Q. Zhang, and C. N. Cao

6313

Response to Comment on "Photocatalytic Oxidation of Arsenite on TiO₂: Understanding the Controversial Oxidation Mechanism Involving Superoxides and the Effect of Alternative Electron Acceptors"

Jungho Ryu and Wonyong Choi

6315

Comment on "Reaction of Polycyclic Aromatic Hydrocarbons Adsorbed on Silica in Aqueous Chlorine"

Frank-Dieter Kopinke and Anett Georgi

ADDITIONS AND CORRECTIONS

6316

Modeling Sorption of Anionic Surfactants onto Sediment