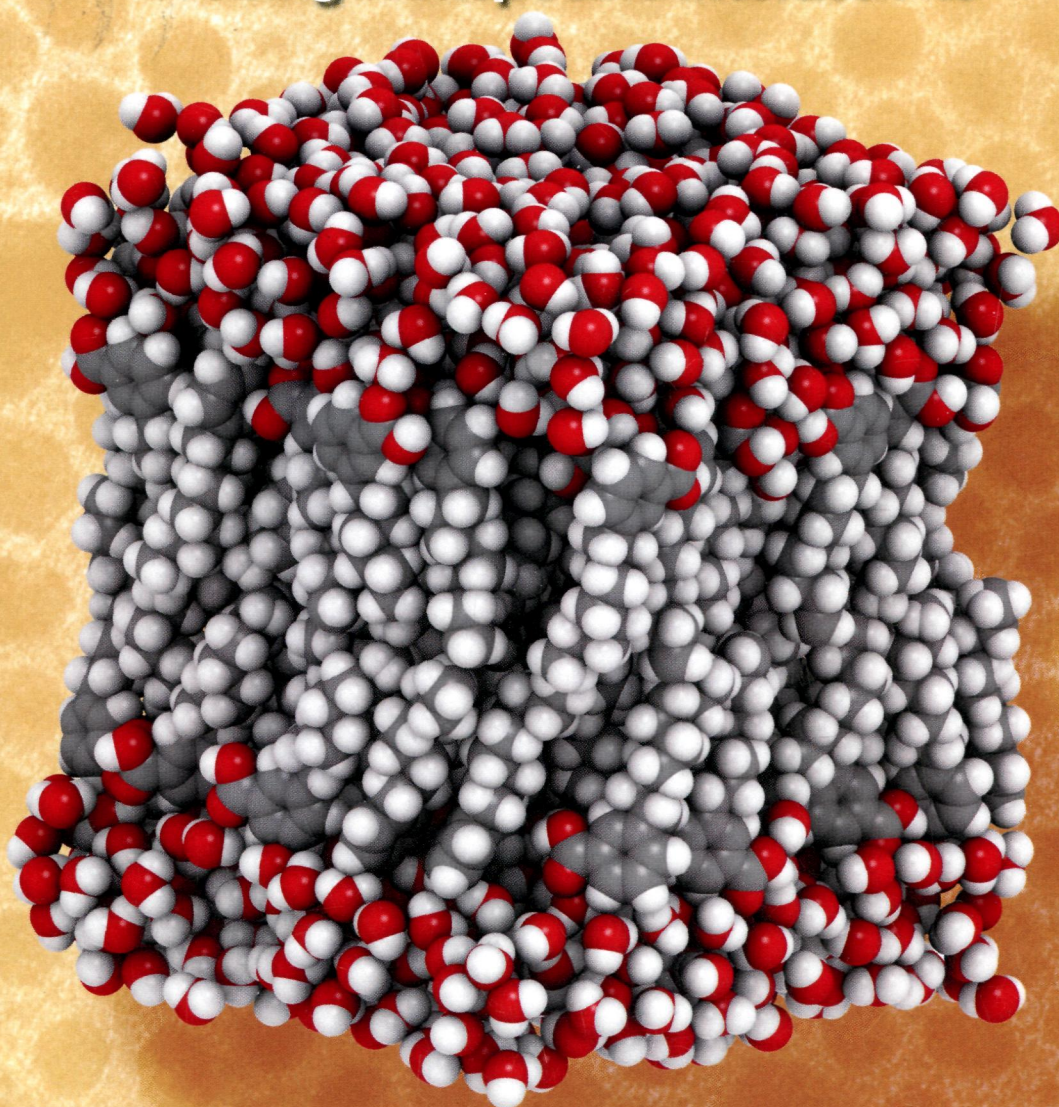


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Nanoparticles Meet Cell Membranes:
Probing Nonspecific Interactions



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ON THE COVER: Physical interactions between engineered nanoparticles and cell membranes play an important role in nanotoxicology. However, mechanisms behind these interactions remain elusive due in part to the complex nature of cell membranes. Model cell membranes (lipid bilayers) are amenable to a range of experimental techniques and provide a versatile tool to study these mechanisms.

Features

873

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Nanoparticles Meet Cell Membranes: Probing Nonspecific Interactions using Model Membranes

Kai Loon Chen* and Geoffrey D. Bothun*

Nanotoxicity studies have shown that both carbon-based and inorganic engineered nanoparticles can be toxic to microorganisms. While the pathways for cytotoxicity are diverse and dependent upon the nature of the engineered nanoparticle and the chemical environment, numerous studies have provided evidence that direct contact between nanoparticles and bacterial cell membranes is necessary for cell inactivation or damage, and may in fact be a primary mechanism for cytotoxicity. The propensities for nanoparticles to attach to and disrupt cell membranes are still not well understood due to the heterogeneous and dynamic nature of biological membranes. Model biological membranes can be employed for systematic investigations of nanoparticle–membrane interactions. In this article, current and emerging experimental approaches to identify the key parameters that control the attachment of ENPs on model membranes and the disruption of membranes by ENPs will be discussed. This critical information will help enable the “safe-by-design” production of engineered nanoparticles that are nontoxic or biocompatible, and also allow for the design of antimicrobial nanoparticles for environmental and biomedical applications. Nanotoxicity studies have shown that both carbon-based and inorganic engineered nanoparticles can be toxic to microorganisms. Although the pathways for cytotoxicity are diverse and dependent upon the nature of the engineered nanoparticle and the chemical environment, numerous studies have provided evidence that direct contact between nanoparticles and bacterial cell membranes is necessary for cell inactivation or damage, and may in fact be a primary mechanism for cytotoxicity. The propensities for nanoparticles to attach to and disrupt cell membranes are still not well understood due to the heterogeneous and dynamic nature of biological membranes. Model biological membranes can be employed for systematic investigations of nanoparticle–membrane interactions. In this article, current and emerging experimental approaches to identify the key parameters that control the attachment of ENPs on model membranes and the disruption of membranes by ENPs will be discussed. This critical information will help enable the “safe-by-design” production of engineered nanoparticles that are nontoxic or biocompatible, and also allow for the design of antimicrobial nanoparticles for environmental and biomedical applications.

Viewpoints

881

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Daphnia magna May Serve As a Powerful Tool in Screening Endocrine Disruption Chemicals (EDCs)


Yuan Kang,* Xiaomin Yan, Laisheng Li, Qiuyun Zhang, Lixuan Zeng, and Jiwen Luo

883

[dx.doi.org/10.1021/es405392c](https://doi.org/10.1021/es405392c)

The creation of farmland by gully filling on the Loess Plateau: a double-edged sword

Zhao Jin*

885  [dx.doi.org/10.1021/es4054779](https://doi.org/10.1021/es4054779)
Metallothioneins May Not Be Enough—The Role of Phytochelatins in Invertebrate Metal Detoxification
Jacob G. Bundy,* Peter Kille, Manuel Liebecke, and David J. Spurgeon

887 [dx.doi.org/10.1021/es405529n](https://doi.org/10.1021/es405529n)
Four Reasons Why Traditional Metal Toxicity Testing with Aquatic Insects Is Irrelevant
Monica D. Poteat and David B. Buchwalter*

889 [dx.doi.org/10.1021/es405553j](https://doi.org/10.1021/es405553j)
Dissolved Methane: A Hurdle for Anaerobic Treatment of Municipal Wastewater
Ze-hua Liu,* Hua Yin, Zhi Dang, and Yu Liu

891 [dx.doi.org/10.1021/es405608b](https://doi.org/10.1021/es405608b)
Fracking and Pollution: Can China Rescue Its Environment In Time?
Meiyu Guo, Yuan Xu,* and Yongqin David Chen

893 [dx.doi.org/10.1021/es405672t](https://doi.org/10.1021/es405672t)
The Data Gap: Can a Lack of Monitors Obscure Loss of Clean Air Act Benefits in Fracking Areas?
Annmarie G. Carlton,* Eleana Little, Michael Moeller, Stella Odoyo, and Paul B. Shepson


Policy Analysis

895  [dx.doi.org/10.1021/es4034364](https://doi.org/10.1021/es4034364)
Spatial Distribution of U.S. Household Carbon Footprints Reveals Suburbanization Undermines Greenhouse Gas Benefits of Urban Population Density
Christopher Jones* and Daniel M. Kammen*

903 [dx.doi.org/10.1021/es4034793](https://doi.org/10.1021/es4034793)
Hidden Cost of U.S. Agricultural Exports: Particulate Matter from Ammonia Emissions
Fabien Paulot* and Daniel J. Jacob


Articles


Characterization of Natural and Affected Environments

909  [dx.doi.org/10.1021/es404622n](https://doi.org/10.1021/es404622n)
Mixing State of Size-Selected Submicrometer Particles in the Arctic in May and September 2012
Kihong Park,* Gibaek Kim, Jae-suk Kim, Young-Jun Yoon, Hee-joo Cho, and Joñan Ström

920  [dx.doi.org/10.1021/es402552u](https://doi.org/10.1021/es402552u)
Seasonal Arsenic Accumulation in Stream Sediments at a Groundwater Discharge Zone
Allison A. MacKay,* Ping Gan, Ran Yu, and Barth F. Smets


930  [dx.doi.org/10.1021/es403723r](https://doi.org/10.1021/es403723r)
Fractal Water Quality Fluctuations Spanning the Periodic Table in an Intensively Farmed Watershed
Alice H. Aubert,* James W. Kirchner, Chantal Gascuel-Oudou, Mikael Faucheux, Gérard Gruau, and Philippe Mérot

938  [dx.doi.org/10.1021/es4040045](https://doi.org/10.1021/es4040045)
SOA Formation Potential of Emissions from Soil and Leaf Litter
Celia L. Faiola, Graham S. VanderSchelden, Miao Wen, Farah C. Elloy, Douglas R. Cobos, Richard J. Watts, B. Thomas Jobson, and Timothy M. VanReken*

947  [dx.doi.org/10.1021/es404599z](https://doi.org/10.1021/es404599z)
Temporal Trends of PCDD/Fs in Baltic Sea Sediment Cores Covering the 20th Century
Anteneh T. Assefa,* Anna Sobek, Kristina L. Sundqvist, Ingemar Cato, Per Jonsson, Mats Tysklind, and Karin Wiberg

Environmental Processes

954  [dx.doi.org/10.1021/es403030d](https://doi.org/10.1021/es403030d)
Sediment-Porewater Partitioning, Total Sulfur, and Methylmercury Production in Estuaries
Amina T. Schartup,* Prentiss H. Balcom, and Robert P. Mason

961  [dx.doi.org/10.1021/es403247k](https://doi.org/10.1021/es403247k)
Deposition and Release of Graphene Oxide Nanomaterials Using a Quartz Crystal Microbalance
Indranil Chowdhury, Matthew C. Duch, Nikhita D. Mansukhani, Mark C. Hersam, and Dermont Bouchard*

970  [dx.doi.org/10.1021/es403640j](https://doi.org/10.1021/es403640j)
Assessing the Effects of Silver Nanoparticles on Biological Nutrient Removal in Bench-Scale Activated Sludge Sequencing Batch Reactors
Christina L. Alito and Claudia K. Gunsch*

977  [dx.doi.org/10.1021/es403698u](https://doi.org/10.1021/es403698u)
Colloid-Facilitated Mobilization of Metals by Freeze–Thaw Cycles
Sanjay K. Mohanty,* James E. Saiers, and Joseph N. Ryan

985  [dx.doi.org/10.1021/es4038325](https://doi.org/10.1021/es4038325)
Brown Carbon Formation by Aqueous-Phase Carbonyl Compound Reactions with Amines and Ammonium Sulfate
Michelle H. Powelson, Brenna M. Espelien, Lelia N. Hawkins, Melissa M. Galloway, and David O. De Haan*

- 994  dx.doi.org/10.1021/es403836g
Cyanobacteria-Mediated Arsenic Redox Dynamics Is Regulated by Phosphate in Aquatic Environments
Siyu Zhang, Christopher Rensing, and Yong-Guan Zhu*
- 1001  dx.doi.org/10.1021/es403877s
Arsenic Uptake by Rice Is Influenced by Microbe-Mediated Arsenic Redox Changes in the Rhizosphere
Yan Jia, Hai Huang, Zheng Chen, and Yong-Guan Zhu*
- 1008  dx.doi.org/10.1021/es403950y
Isomer-Specific Biodegradation of Nonylphenol in River Sediments and Structure-Biodegradability Relationship
Zhijiang Lu and Jay Gan*
- 1015  dx.doi.org/10.1021/es404186v
Accessibility of Humic-Associated Fe to a Microbial Siderophore: Implications for Bioavailability
Keshia M. Kuhn, Patricia A. Maurice,* Elisabeth Neubauer, Thilo Hofmann, and Frank von der Kammer
- 1023  dx.doi.org/10.1021/es404260f
Fate and Transport of Ambient Mercury and Applied Mercury Isotope in Terrestrial Upland Soils: Insights from the METAALICUS Watershed
Claire J. Oswald,* Andrew Heyes, and Brian A. Branfireun
- 1032  dx.doi.org/10.1021/es4042644
Reservoir Stratification Affects Methylmercury Levels in River Water, Plankton, and Fish Downstream from Balbina Hydroelectric Dam, Amazonas, Brazil
Daniele Kasper,* Bruce R. Forsberg, João H. F. Amaral, Rafael P. Leitão, Sarah S. Py-Daniel, Wanderley R. Bastos, and Olaf Malm
- 1041  dx.doi.org/10.1021/es404515k
Heterogeneous OH Initiated Oxidation: A Possible Explanation for the Persistence of Organophosphate Flame Retardants in Air
Yongchun Liu, John Liggio,* Tom Harner, Liisa Jantunen, Mahiba Shoeib, and Shao-Meng Li
- 1049  dx.doi.org/10.1021/es4045715
Secondary Organic Aerosol Production from Aqueous Reactions of Atmospheric Phenols with an Organic Triplet Excited State
Jeremy D. Smith, Vicky Sio, Lu Yu, Qi Zhang, and Cort Anastasio*
- 1058  dx.doi.org/10.1021/es404867w
Isomer-Specific Accumulation of Perfluorooctanesulfonate from (N-Ethyl perfluorooctanesulfonamido)ethanol-based Phosphate Diester in Japanese Medaka (*Oryzias latipes*)
Hui Peng, Shiyi Zhang, Jianxian Sun, Zhong Zhang, John P. Giesy, and Jianying Hu*


Environmental Modeling


- 1067  dx.doi.org/10.1021/es4017014
Multiwell CO₂ Injectivity: Impact of Boundary Conditions and Brine Extraction on Geologic CO₂ Storage Efficiency and Pressure Buildup
Jason E. Heath,* Sean A. McKenna, Thomas A. Dewers, Jesse D. Roach, and Peter H. Kobos
- 1075  dx.doi.org/10.1021/es403080t
The Magnitude and Spatial Range of Current-Use Urban PCB and PBDE Emissions Estimated Using a Coupled Multimedia and Air Transport Model
Susan A. Csiszar, Miriam L. Diamond,* and Sreerama M. Daggupati
- 1084  dx.doi.org/10.1021/es403447v
High-Global Warming Potential F-gas Emissions in California: Comparison of Ambient-Based versus Inventory-Based Emission Estimates, and Implications of Refined Estimates
Glenn Gallagher,* Tao Zhan, Ying-Kuang Hsu, Pamela Gupta, James Pederson, Bart Croes, Donald R. Blake, Barbara Barletta, Simone Meinardi, Paul Ashford, Amie Vetter, Sabine Saba, Rayan Slim, Lionel Palandre, Denis Clodic, Pamela Mathis, Mark Wagner, Julia Forgie, Harry Dwyer, and Katy Wolf
- 1094  dx.doi.org/10.1021/es404082f
Seeking Sustainability: Multiobjective Evolutionary Optimization for Urban Wastewater Reuse in China
Wenlong Zhang, Chao Wang,* Yi Li,* Peifang Wang, Qing Wang, and Dawei Wang
- 1103  dx.doi.org/10.1021/es4042429
Decoupling Analysis and Socioeconomic Drivers of Environmental Pressure in China
Sai Liang,* Zhu Liu, Douglas Crawford-Brown, Yafei Wang, and Ming Xu*
- ## Environmental Measurements Methods
- 1114  dx.doi.org/10.1021/es403381s
Method for Obtaining Silver Nanoparticle Concentrations within a Porous Medium via Synchrotron X-ray Computed Microtomography
Ian L. Molnar, Clinton S. Willson, Denis M. O'Carroll,* Mark L. Rivers, and Jason I. Gerhard
- 1123 dx.doi.org/10.1021/es403354n
Approaches for Achieving Long-Term Accuracy and Precision of $\delta^{18}\text{O}$ and $\delta^2\text{H}$ for Waters Analyzed using Laser Absorption Spectrometers
Leonard I. Wassenaar,* Tyler B. Coplen, and Pradeep K. Aggarwal
- 1132  dx.doi.org/10.1021/es4033716
Closing Data Gaps for LCA of Food Products: Estimating the Energy Demand of Food Processing
Neus Sanjuán,* Franziska Stoessel, and Stefanie Hellweg


1141  dx.doi.org/10.1021/es4038319
Biosensor for Organoarsenical Herbicides and Growth Promoters
Jian Chen, Samio Sun, Chen-Zhong Li, Yong-Guan Zhu, and Barry P. Rosen*


Remediation and Control Technologies

1148  dx.doi.org/10.1021/es405080g
Mechanisms of Physically Irreversible Fouling during Surface Water Microfiltration and Mitigation by Aluminum Electroflotation Pretreatment
Neranga P. Gamage and Shankararaman Chellam*


1158  dx.doi.org/10.1021/es403337t
Interaction of Heavy Metals and Pyrene on Their Fates in Soil and Tall Fescue (*Festuca arundinacea*)
Mang Lu, Zhong-Zhi Zhang,* Jing-Xiu Wang, Min Zhang, Yu-Xin Xu, and Xue-Jiao Wu

1166  dx.doi.org/10.1021/es403929b
Zirconium–Carbon Hybrid Sorbent for Removal of Fluoride from Water: Oxalic Acid Mediated Zr(IV) Assembly and Adsorption Mechanism
Litza Halla Velazquez-Jimenez, Robert H. Hurt, Juan Matos, and Jose Rene Rangel-Mendez*

1175  dx.doi.org/10.1021/es404108h
Bioturbation Delays Attenuation of DDT by Clean Sediment Cap but Promotes Sequestration by Thin-Layered Activated Carbon
Diana Lin, Yeo-Myoung Cho, David Wemer, and Richard G. Luthy*


1184  dx.doi.org/10.1021/es4047395
Integrated Metabolomic and Proteomic Approaches Dissect the Effect of Metal-Resistant Bacteria on Maize Biomass and Copper Uptake
Kefeng Li, Venkataramana R. Pidatala, Rafi Shaik, Rupali Datta, and Wusirika Ramakrishna*

Sustainability Engineering and Green Chemistry

1194  dx.doi.org/10.1021/es4034638
Evaluating the Environmental Impacts of a Nano-Enhanced Field Emission Display Using Life Cycle Assessment: A Screening-Level Study
Venkata K. K. Upadhyayula, David E. Meyer,* Mary Ann Curran, and Michael A. Gonzalez

Ecotoxicology and Human Environmental Health


1206 dx.doi.org/10.1021/es4051082
New Insights into Traditional Health Risk Assessments of Mercury Exposure: Implications of Selenium
Hua Zhang, Xinbin Feng,* Hing Man Chan, and Thorjorn Larssen


1213  dx.doi.org/10.1021/es402186w
Influence of Salinity and Dissolved Organic Carbon on Acute Cu Toxicity to the Rotifer *Brachionus plicatilis*
Christopher A. Cooper, Tara Tait, Holly Gray, Giselle Cimprich, Robert C. Santore, James C. McGeer, Christopher M. Wood, and D. Scott Smith*


1222  dx.doi.org/10.1021/es402630z
Predicting Cadmium Accumulation and Toxicity in a Green Alga in the Presence of Varying Essential Element Concentrations Using a Biotic Ligand Model
Michel Lavoie, Peter G. C. Campbell, and Claude Fortin*


1230  dx.doi.org/10.1021/es405490a
Dermal Uptake of Organic Vapors Commonly Found in Indoor Air
Charles J. Weschler* and William W Nazaroff


1238 dx.doi.org/10.1021/es4036122
Bioaccessibility of As, Cd, Cu, Ni, Pb, and Sb in Toys and Low-Cost Jewelry
Mert Guney and Gerald J. Zagury*

1247  dx.doi.org/10.1021/es403688w
Longitudinal Effects on Mental Health of Moving to Greener and Less Green Urban Areas
Ian Alcock, Mathew P. White,* Benedict W. Wheeler, Lora E. Fleming, and Michael H. Depledge

1256  dx.doi.org/10.1021/es403781z
Ecological Risk of Nonylphenol in China Surface Waters Based on Reproductive Fitness
Xiaowei Jin, Yeyao Wang, Wei Jin, Kaifeng Rao, John P. Giesy, Henner Hollert, Kristine L. Richardson, and Zijian Wang*

1263  dx.doi.org/10.1021/es4039825
Contribution of Particle-Size-Fractionated Airborne Lead to Blood Lead during the National Health and Nutrition Examination Survey, 1999–2008
Qingyu Meng, Jennifer Richmond-Bryant,* J. Allen Davis, Jonathan Cohen, David Svendsgaard, James S. Brown, Lauren Tuttle, Heidi Hubbard, Joann Rice, Lisa Vinikoor-Imler, Jason D. Sacks, Ellen Kिरrane, Dennis Kotchmar, Erin Hines, and Mary Ross


1271  dx.doi.org/10.1021/es404258h
Effects of Glyphosate and its Formulation, Roundup, on Reproduction in Zebrafish (*Danio rerio*)
Tamsyn M. Uren Webster,* Lauren V. Laing, Hannah Florence, and Eduarda M. Santos*

1280  dx.doi.org/10.1021/es404503c
Influence of Natural Organic Matter and Surface Charge on the Toxicity and Bioaccumulation of Functionalized Ceria Nanoparticles in *Caenorhabditis elegans*
Blanche Collin,* Emily Oostveen, Olga V. Tsyusko, and Jason M. Unrine*


1290  [dx.doi.org/10.1021/es4045874](https://doi.org/10.1021/es4045874)
Toxicity of the Insecticide Fipronil and Its Degradates to Benthic Macroinvertebrates of Urban Streams
Donald P. Weston* and Michael J. Lydy

Energy and the Environment

1298  [dx.doi.org/10.1021/es404877u](https://doi.org/10.1021/es404877u)
Managing Critical Materials with a Technology-Specific Stocks and Flows Model
Jonathan Busch,* Julia K. Steinberger, David A. Dawson, Phil Purnell, and Katy Roelich


1306  [dx.doi.org/10.1021/es4027985](https://doi.org/10.1021/es4027985)
Viability and Adaptation Potential of Indigenous Microorganisms from Natural Gas Field Fluids in High Pressure Incubations with Supercritical CO₂
Janin Frenichs, Jana Rakoczy, Christian Ostertag-Henning, and Martin Krüger*

1315 [dx.doi.org/10.1021/es4043726](https://doi.org/10.1021/es4043726)
Land-Use Efficiency of Big Solar
Rebecca R. Hernandez,* Madison K. Hoffacker, and Christopher B. Field

1324  [dx.doi.org/10.1021/es403203d](https://doi.org/10.1021/es403203d)
Transition Metal Associations with Primary Biological Particles in Sea Spray Aerosol Generated in a Wave Channel
Timothy L. Guasco, Luis A. Cuadra-Rodriguez, Byron E. Pedler, Andrew P. Ault, Douglas B. Collins, Defeng Zhao, Michelle J. Kim, Matthew J. Ruppel, Scott C. Wilson, Robert S. Pomeroy, Vicki H. Grassian, Farooq Azam, Timothy H. Bertram, and Kimberly A. Prather*

1334  [dx.doi.org/10.1021/es403852h](https://doi.org/10.1021/es403852h)
Radium and Barium Removal through Blending Hydraulic Fracturing Fluids with Acid Mine Drainage
Andrew J. Kondash, Nathaniel R. Warner, Ori Lahav, and Avner Vengosh*


1343 [dx.doi.org/10.1021/es404185m](https://doi.org/10.1021/es404185m)
Chemical Characterization and Source Apportionment of Household Fine Particulate Matter in Rural, Peri-urban, and Urban West Africa
Zheng Zhou, Kathie L. Dionisio, Thiago G. Verissimo, Americo S. Kerr, Brent Coull, Stephen Howie, Raphael E. Arku, Petros Koutrakis, John D. Spengler, Kimberly Fornace, Allison F. Hughes, Jose Vallarino, Samuel Agyei-Mensah, and Majid Ezzati*

1352  [dx.doi.org/10.1021/es404690q](https://doi.org/10.1021/es404690q)
Microbial Community Composition Is Unaffected by Anode Potential
Xiuping Zhu, Matthew D. Yates, Marta C. Hatzell, Hari Ananda Rao, Pascal E. Saikaly, and Bruce E. Logan*

Correspondence

1359 [dx.doi.org/10.1021/es404912p](https://doi.org/10.1021/es404912p)
Comment on “Colloidal Properties and Stability of Graphene Oxide Nanomaterials in the Aquatic Environment”
Jianfeng Zhang, Amalia Terracciano, and Xiaoguang Meng*

1360 [dx.doi.org/10.1021/es405531h](https://doi.org/10.1021/es405531h)
Response to Comment on “Colloidal Properties and Stability of Graphene Oxide Nanomaterials in the Aquatic Environment”
Indranil Chowdhury, Matthew C. Duch, Nikhita D. Mansukhani, Mark C. Hersam, and Dermont Bouchard*

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