

Christopher M. Sales

Assistant Professor

Department of Civil, Architectural, and Environmental Engineering

Drexel University

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EDUCATION

<i>Ph.D., Civil and Environmental Engineering</i> University of California, Berkeley, CA	2012
<i>M.S., Civil and Environmental Engineering</i> University of California, Berkeley, CA	2006
<i>B.S.E., Chemical and Biomolecular Engineering</i> University of Pennsylvania, Philadelphia, PA	2005
<i>B.A., Environmental Studies with Distinction</i> University of Pennsylvania, Philadelphia, PA	2005

PROFESSIONAL EXPERIENCE

<i>Assistant Professor</i> Department of Civil, Architectural, and Environmental Engineering Drexel University, Philadelphia, PA	2013-present
<i>Post-doctoral Researcher</i> Department of Civil, Architectural, and Environmental Engineering Drexel University, Philadelphia, PA	2012-2013
<i>Adjunct Professor</i> Department of Civil, Architectural, & Environmental Engineering Drexel University, Philadelphia, PA	2012-2013

RESEARCH EXPERIENCE

<i>Post-Doctoral Researcher</i> Department of Civil, Architectural and Environmental Engineering Office of the Dean of Engineering Drexel University, Philadelphia, PA Advisor: Joseph B. Hughes, Ph.D., P.E., D.E.E. <ul style="list-style-type: none">• Bioremediation of soils contaminated with nitroaromatics in laboratory-scale, pilot-scale, and field-scale systems	2012-2013
<i>Post-Doctoral Researcher</i> Department of Civil, Architectural and Environmental Engineering Drexel University, Philadelphia, PA Principal Investigator(s): Mira S. Olson, Ph.D. (Drexel University) and Wen K. Shieh, Ph.D. (University of Pennsylvania) <ul style="list-style-type: none">• Design and evaluation of combined microalgae and bacterial systems for treatment of wastewaters and production of commodities and bioenergy	2012-2013
<i>Doctoral Researcher</i> Department of Civil and Environmental Engineering University of California, Berkeley, CA Advisor: Lisa Alvarez-Cohen, Ph.D. <ul style="list-style-type: none">• Functional genomics analysis of the 1,4-dioxane degrading bacterial strain <i>Pseudonocardia dioxanvorans</i> strain CB1190.	2006-2012

- Comparative genomics of the family *Pseudonocardiaceae*.
- Molecular biology and microbiology studies of bacterial biodegradation of the emerging water contaminants, 1,4-dioxane and *N*-nitrosodimethylamine.

Affiliated Researcher 2010-2012

Earth Sciences Division
Lawrence Berkeley National Laboratory, Berkeley, CA
Collaborator: Gary Andersen, Ph.D.

- Microarray transcriptomics of *Pseudonocardia dioxanivorans* strain CB1190

Visiting Researcher 2006

Department of Microbiology and Immunology
University of British Columbia, Vancouver, Canada.
Collaborators: William Mohn, Ph.D. and Lindsay Eltis, Ph.D.

- Functional genomics analysis of propane-induced biodegradation of *N*-nitrosodimethylamine by *Rhodococcus jostii* RHA1.

Research Assistant 2002-2005

Department of Chemical and Biomolecular Engineering
University of Pennsylvania, Philadelphia, PA
Advisor: Wen K. Shieh

- Designed and evaluated the performance of novel bioreactor systems for wastewater treatment and continuous fermentation

HONORS AND AWARDS

1. Harry C. Bartels, Endowed Faculty Engineering Development Fund, 2014. Drexel University. \$20,000 Award.
2. International Travel Award. 2014. Office of International Programs, Drexel University. \$500 Award.
3. Appreciation Award from The Greater Philadelphia Region NSF Louis Stokes Alliance for Minority Participation (LSAMP), November 16, 2013. "For dedication, continuous inspiration, and outstanding contribution to science and engineering students."

PEER-REVIEWED PUBLICATIONS

1. Nayak, S., O'Donnell, S.-E., **Sales, C.M.**, and R.V. Tikekar. 2016. Fructose accelerates UV-C induced photochemical degradation of pentachlorophenol in low and high salinity water. *J. Agric. Food Chem.* DOI: 10.1021/acs.jafc.6b01449.
2. Price, J.R., Keshani Langroodi, S., Lan, Y., Becker, J.M., Shieh, W.K., Rosen., G.L., and **C.M. Sales**. 2016. Untangling the microbial ecosystem and kinetics in a nitrogen removing photosynthetic high density bioreactor. *Environ. Sci.: Water Res. Technol.* DOI: 10.1039/c6ew00078a.
3. Nayak, S., **Sales, C.M.**, Muniz, J., and R.V. Tikekar. 2016. Fructose as a novel photosensitizer: Characterization of reactive oxygen species and an application in degradation of diuron and chlorpyrifos. *Chemosphere*. 144:1690-1697.
4. Sniffen, K.D., **Sales, C.M.**, and M.S. Olson. 2016. Nitrogen removal from raw landfill leachate by an algae-bacteria consortium. *Water Sci. Technol.* DOI: 10.2166/wst.2015.499
5. Price, J.R., Shieh, W.K., and **CM. Sales**. 2015. A novel bioreactor for high density cultivation of diverse microbial communities. *J. Vis. Exp.* 106:e53443.
6. **Sales, C.M.** and P.K.H. Lee. 2015. Resource recovery from wastewater: application of meta-omics to phosphorus and carbon management. *Curr. Opin. Biotechnol.* 26(33):260-267.
7. Ramanathan, G., **Sales, C.M.**, and W. K. Shieh. 2014. Simultaneous autotrophic denitrification and nitrification in a low-oxygen reaction environment. *Water Sci. Technol.* doi:10.2166/wst.2014.292

8. **Sales, C.M.**, Grostern, A., Parales, J.V., Parales, R.E., and L. Alvarez-Cohen. 2013. Oxidation of the cyclic ethers 1,4-dioxane and tetrahydrofuran by a monooxygenase in two *Pseudonocardia* species. *Appl. Environ. Microbiol.* 79(24):7702-7708.
9. Gedalanga, P., Kotay, S.M, **Sales, C.M.**, Butler, C.S., Goel, R., and Mahendra, S. 2013. Novel Applications of molecular biological and microscopic tools in environmental engineering. *Water Environ. Res.* 85(10):917-950.
10. Grostern, A., **Sales, C.M.**, Zhuang, W.Q., Erbilgin, O., Parales, R.E., and L. Alvarez-Cohen. 2012. Glyoxylate metabolism is a key feature of the metabolic degradation of 1,4-dioxane by *Pseudonocardia dioxanivorans* strain CB1190. *Appl. Environ. Microbiol.* 78:3298-3308.
11. **Sales, C.M.**, Mahendra, S., Grostern, A., Parales, R.E., Goodwin, L., Woyke, T., Nolan, M., Lapidus, A., Chertkov, O., Ovchinnikova, G., Szcyrba, A., and L. Alvarez-Cohen. 2011. Genome sequence of 1,4-dioxane degrading *Pseudonocardia dioxanivorans* strain CB1190. *J. Bacteriol.* 193:4459-4550.
12. Sharp, J.O.*, **Sales, C.M.*** and L. Alvarez-Cohen. 2010. Functional characterization of propane-enhanced *N*-nitrosodimethylamine degradation by two actinomycetales. *Biotechnol. Bioeng.* 107(6):924-932.
*Both authors contributed equally to this manuscript.
13. Sharp J.O., **Sales C.M.**, LeBlanc J.C., Liu J., Wood T.K., Eltis L.D., Mohn W.W., and L. Alvarez-Cohen. 2007. An inducible propane monooxygenase is responsible for n-nitrosodimethylamine degradation by *Rhodococcus* sp. Strain RHA1. *Appl. Environ. Microbiol.* 73:6930-6938.
14. **Sales C.M** and W.K. Shieh. 2006. Performance of an aerobic/anaerobic hybrid bioreactor under nitrogen deficient and low F/M conditions. *Water Research* 40(7):1442-1448.

REFEREED CONFERENCE PROCEEDINGS

15. Muth, D., Rodriguez, E., **Sales, C.M.**, Retallick, W.B., and S.W. Churchill. 2005. An Economic and Thermodynamic Evaluation of the Conversion of Natural Gas to Liquid Fuels Using an Ion-Transport Membrane. Proceedings of the 2005 AIChE Annual Meeting. Cincinnati, OH.

ORAL PRESENTATIONS

1. Ledford, S.H., Price, Jacob R., Ryan, M., Perez, L.B., **Sales, C.M.**, and L. Toran. 2016. Using a multi-parameter biogeological approach to track the impact of treated sewage discharge on urban streams. *Abstracts with Programs.* 48(7). Denver, CO, USA. Geological Society of America. doi:10.1130/abs/2016AM-286553.
2. **C.M. Sales.** 2015. Application of Functional and Genome-Resolved Metagenomics to Environmental Remediation Systems. Civil and Environmental Engineering Friday Noon Seminar Series at Temple University. Philadelphia, PA.
3. **C.M. Sales.** 2015. Mighty Environmental Microbes: Harnessing Their Powers to Protect Our Water Resources. American Water Resources Association – Philadelphia Metro Area Section Seminar Series. Philadelphia, PA.
4. **C.M. Sales.** 2015. Application of Functional and Genome-Resolved Metagenomics to Environmental Remediation and Biotechnology Systems. Microbiology and Biochemistry Seminar Series at Rutgers University. New Brunswick, NJ.
5. Price, J.R. and **C.M. Sales.** 2015. Microalgae: Harnessing Diverse Metabolisms for Environmental Remediation and Waste Stream Treatment. 2015 Annual Meeting of the Phycological Society of America. Philadelphia, PA.
6. **C.M. Sales.** 2015. Functional Genomics of the Biodegradation of the Emerging Contaminant 1,4-Dioxane. Annual Meeting and Exhibition for the Society of Industrial Microbiology. Philadelphia, PA.

7. **C.M. Sales.** 2015 Mighty Environmental Microbes: Harnessing Their Powers For Treatment of Human Waste and Remediation of Pollution. Tapping Our Watershed Seminar Series. Delaware River Watershed Institute. The Academy of Natural Sciences of Drexel University. Philadelphia, PA.
8. **Sales, C.M.** 2014. Application of Functional Genomics to Advance the Biodegradation of Emerging Contaminants. Invited Seminar at the School of Energy and Environment at the City University of Hong Kong, HK.
9. **Sales, C.M.** 2014. Next Generation Molecular Biology Methods for Advancing the Activated Sludge Process. Contributed talk for the workshop celebrating “100th Years of the Activated Sludge Process” at the 99th Annual Conference of the New Jersey Water Environment Association (NJWEA). Atlantic City, NJ.
10. **Sales, C.M.** 2012. Enhancing biodegradation with OMICS: the story of the emerging water contaminants, 1,4-dioxane and n-nitrosodimethylamine (NDMA). Environmental Engineering Seminar Series, Department of Civil, Architectural, and Environmental Engineering, Drexel University. Philadelphia, PA.
11. **Sales, C.M.** 2012. Utilizing “OMICS” to Enhance Biodegradation: A New Guiding Light for Bioremediation Research. Environmental Engineering Seminar Series, Department of Civil and Environmental Engineering, University of California, Los Angeles, CA.
12. **Sales, C.M.** 2007. *N*-nitrosodimethylamine (NDMA), Oxygenases and Bioremediation. Water Quality Seminar Series, Department of Civil and Environmental Engineering, University of California, Berkeley, CA.

POSTER PRESENTATIONS

1. Price, J.R. and **C.M. Sales.** 2016. Resolving the relationships between photobioreactor influent, microbial diversity and abundance, and reactor performance with a high density bioreactor. International Symposium on Microbial Ecology. Montreal, Canada.
2. Price, J.R., Shieh, W.K., and **C.M. Sales.** 2015. A Novel Photobioreactor for Studying Nitrogen Utilization and Transformation by a Mixed Community of Algae and Bacteria Grown at High Cell Densities. 2015 AEESP Research and Education Conference. New Haven, CT.
3. Sniffen, K.D., **Sales, C.M.**, and M.S. Olson. 2015. Simultaneous bio-remediation of leachate and production of algae for biofuel. 2015 AEESP Research and Education Conference. New Haven, CT.
4. Price, J.R., Shieh, W.K., and **C.M. Sales.** 2015. Nitrogen Removal Dynamics by a Photosynthetic Microbial Community Under High Cell Densities. 2015 Pennsylvania American Water Works Association Annual Conference. Hershey, PA. April 22, 2015.
5. Lan, Y., Stenuit, B., Rosen, G., Hughes, J., Alvarez-Cohen, L., and **C.M. Sales.** 2014. Effects of historical 2,4,6-trinitrotoluene (TNT) contamination and periodic mechanical tillage on soil microbial consortia and remediation activity. 15th International Symposium on Microbial Ecology. Seoul, South Korea.
6. Sniffen, K., **Sales, C.M.**, and Olson, M.S. 2013. Nutrient Removal from Leachate by Bioassimilation. EREF Regional Summit on Sustainable Solid Waste Practices & Research. Philadelphia, PA.
7. Grostern, A., **Sales, C.M.**, and L. Alvarez-Cohen. 2013. Cloning and heterologous functional expression of tetrahydrofuran monooxygenases from *Pseudonocardia* strains in *Rhodococcus jostii* RHA1. 113th General Meetings of the American Society for Microbiology. Denver, CO.
8. **Sales, C.M.**, Han, S.S., and J.B. Hughes. 2013. Biodegradation of dinitrotoluenes in historically contaminated soils without nutrient addition. 2013 RemTEC Summit 2013. Westminster, CO.

9. **Sales, C.M.**, Grostern, A., Mahendra, S., Parales, R.E., and L. Alvarez-Cohen. 2011. The genome sequence of *Pseudonocardia dioxanivorans* strain CB1190. 111th General Meeting of the American Society for Microbiology. New Orleans, LA.
10. Zhuang, W.Q., **Sales, C.M.**, Grostern, A., Feng, X.Y., Tang, Y.J., and L. Alvarez-Cohen. 2011. Demonstration of C2 compounds assimilation pathways in *Pseudonocardia dioxanivorans* CB1190 using ¹³C isotopic tracer analysis. 111th General Meeting of the American Society for Microbiology. New Orleans, LA.
11. Grostern, A., **Sales, C.M.**, Zhuang, W.Q., Erbilgin, O., Parales, R.E., Mahendra, S., and L. Alvarez-Cohen. 2011. Towards a genetic and biochemical understanding of bacterial 1,4-dioxane metabolism. 111th General Meeting of the American Society for Microbiology. New Orleans, LA.
12. Grostern, A., **Sales, C.M.**, Zhuang, W.Q., Mahendra, S., and L. Alvarez-Cohen. 2010. A genome-enabled investigation of 1,4-dioxane metabolism by *Pseudonocardia dioxanivorans* strain CB1190. 2010 Partners in Environmental Technology Symposium and Workshop, SERDP and ESTCP. Washington, D.C.
13. Grostern, A., **Sales, C.M.**, Mahendra, S., and L. Alvarez-Cohen. 2010. Genome assembly of the 1,4-dioxane degrading *Pseudonocardia dioxanivorans* strain CB1190. ISME-13 Symposium, Microbes – Stewards of a changing planet, International Society for Microbial Ecology. Seattle, WA.
14. **Sales, C.M.**, Grostern, A., Mahendra, S., and L. Alvarez-Cohen. 2010. Identification of monooxygenases involved in 1,4-dioxane biodegradation by *Pseudonocardia dioxanivorans* CB1190. 110th General Meeting of the American Society for Microbiology. San Diego, CA.
15. **Sales, C.M.**, Mahendra, S., Grostern, A., Parales, R.E., and L. Alvarez-Cohen. 2009. Genome sequencing of the 1,4-dioxane-utilizing bacterium *Pseudonocardia dioxanivorans* CB1190. 2009 Partners in Environmental Technology Symposium and Workshop, SERDP and ESTCP. Washington, D.C.

THESES

Sales, C.M. 2012. Functional genomics of bacterial degradation of the emerging contaminants, 1,4-dioxane and *N*-nitrosodimethylamine (NDMA). University of California, Berkeley. Advisor: Alvarez-Cohen, L. Readers: Firestone, M.K. and Neslon, K.L.

Sales, C.M. 2005. Performance Study of a Novel, Aerobic/Anaerobic Hybrid Biological Reactor for Treatment of Wastewater. Environmental Studies Senior Thesis, University of Pennsylvania, Philadelphia, PA.

TEACHING EXPERIENCE

Courses Developed and Taught

ENVE 662: Environmental Engineering Unit Ops – Biological Processes

Department of Civil, Architectural and Environmental Engineering
Drexel University, Philadelphia, PA
(Spring 2015, Spring 2013)

ENVE 661: Environmental Engineering Op – Physical & Chemical

Department of Civil, Architectural and Environmental Engineering
Drexel University, Philadelphia, PA
(Spring 2015, Spring 2014)

ENVE 660: Chemical Processes in Environmental Engineering

Department of Civil, Architectural and Environmental Engineering
Drexel University, Philadelphia, PA
(Winter 2015, Winter 2014)

ENVE 316/516: Fundamentals of Environmental Biotechnology

Department of Civil, Architectural and Environmental Engineering

Drexel University, Philadelphia, PA
(Fall 2014, Fall 2013, Winter 2013)

Courses Taught

ENVE 302: Environmental Transport and Kinetics
Department of Civil, Architectural and Environmental Engineering
Drexel University, Philadelphia, PA
(Summer 2012)

Guest Lectures

CAEE 201: Introduction to Infrastructure Engineering
Department of Civil, Architectural and Environmental Engineering
Drexel University, Philadelphia, PA
(Fall 2013, Spring 2014, Fall 2014, Spring 2015, Fall 2015, Spring 2016)

CAEE 210: Measurements in CAEE Engineering
Department of Civil, Architectural and Environmental Engineering
Drexel University, Philadelphia, PA
(Summer 2014, Winter 2015, Summer 2015)

FUNDED PROJECTS

1. Genomics Core Facility Seed Funding for pilot project titled, "PacBio Amplicon Sequencing for Microbial Source Tracking in the Delaware River Watershed." College of Medicine Clinical & Translational Research Institute – Genomics Core Facility (CTRI-GCF). Drexel University. \$10,000 Award. June 2016 – May 2017. (Drexel Internal)
2. Drexel Watershed Consortium Grant Award for research project titled, "Development and Use of Molecular Tools for Microbial Source Tracking and Water Quality Characterization." 2016. Two year. \$60,000 Award. June 2016 – May 2018. (Drexel Internal)
3. R.V. Tikekar and **C.M. Sales**. Novel Photochemical and Biological Processes for Decontamination of Flowback Water from Hydraulic Fracturing of the Marcellus Shale. IExE Seed Grant. \$50,000 Award. June 2014 – October 2015. (Drexel Internal).

STUDENT ADVISING AND MENTORING

Ph.D. Students

Jacob Price, Ph.D. candidate exp. 2017
Linking Complex Kinetics and Molecular Ecology Dynamics within a
Photosynthetic Mixed Microbial Community

Kaitlyn Sniffen, Ph.D. candidate exp. 2017
Use of algae in a landfill leachate treatment system

Saeed Keshani Langroodi, Ph.D. candidate exp. 2018
Application of Meta-Omics to Environmental Remediation

Lindsay B. Perez exp. 2020
Microbial Source Tracking of the Delaware River Watershed

M.S. Students

Shaila Nayak, M.S. (Food Sciences) 2015
UV induced photolysis of fructose: Generation of reactive oxygen species and
their application in photo-degradation of pesticides

Taylor Rycroft exp. 2016
Biodegradation of Fluorotelomer chemicals found in AFFF

Ph.D. Thesis Committees

Yemin Lan, Ph.D. (Biomed) 2015

A study of microbial diversity using comparative genomics and comparative metagenomics methods	
<i>Kerry Hamilton, Ph.D. candidate</i>	exp. 2017
Quantitative microbial risk assessment for harvested rainwater, green infrastructure, and reclaimed water	
<i>Undergraduate Students</i>	
<i>Kaitlyn Brubaker</i> (BS ENVE '14, Drexel University) Undergraduate Research Assistant	2014
<i>Timothy Bruckner</i> (BS ENVE '14, Drexel University) Independent Study	2014
<i>Sean-Erik O'Donnell</i> (BS/MS ENVE '15, Drexel University) Independent Study/Research Assistant	2014-2015
<i>Melika Riley</i> (BS ENVE '15, Drexel University) Undergraduate Research Assistant	2015
<i>Breauna Branch</i> (BA Biology exp. '16, Lincoln University) Louis Stokes Alliance for Minority Participation (LSAMP) Research Scholar	2015
<i>Benjamin Yezuita</i> (BS/MS ENVE exp. '16, Drexel University) Independent Study	2015
<i>Thomas Thompson</i> (BS/MS ENVE exp. '16, Drexel University) Undergraduate Research Co-op	2015
<i>Marina D'Souza</i> (BS ENVE exp. '20, Drexel University) Freshmen Design Project/STAR Scholar	2016
<i>Fatima Hassan</i> (BS ECE exp. '20, Drexel University) Freshmen Design Project	2016
<i>Juan Francisco Hidalgo</i> (BS CIVE and ENVE exp. '20, Drexel University) Independent Study	2016
<i>High School Students</i>	
<i>Kayin Bankole</i> Franklin Institute STEM Scholar **Now Majoring in Environmental Engineering at Syracuse University	2014
<i>Semir Ibrahim</i> Franklin Institute STEM Scholar	2015
<i>Senior Design Groups Advised</i>	
<i>Remediation of Baghurst Drive, Harleysville, PA</i> (Students: Melika Riley, Nicole Stilwell, Maria Tortorelli, Amy Wetherby)	2014-2015
<i>The Dirt Factory</i> (EPICS) (Students: Achira Amur, Rebecca Barnes, Frank Kivuyo, Yujie Su, Bai Xue)	2014-2015
<i>Biogas Production in Anaerobic Digestion</i> (Students: James Cirelli, Leonard Lui, Sean O'Donnell, Alex Newhart)	2014-2015
<i>Friends of the Cresheim Trail</i> (EPICS) (Students: Dylan Myers, Merissa Gray, Beatrice Mwonga)	2015-2016
<i>Remediation of PFOS and PFOA in Subsurface of NAS JRB Willow Grove</i> (Students: Azeem Merchant, Samantha Schneider, Benjamin Yezuita)	2015-2016
<i>Low Impact Dredging Method</i> (MEM)	2015-2016

(Students: Edmont Caffarra, David Gockley, Tuyen Christina Hoang, Andrew Johnson, Joy Yingling)

Student Awards and Fellowships

Graduate Assistance in Areas of National Need (GANN) Grand Challenges Fellowship

Jacob Price 2015
Kaitlyn Sniffen 2015 - present

Claudio Elia Memorial Fellowship

Jacob Price 2015

The George Hill, Jr. Endowed Fellowship

Kaitlyn Sniffen 2015

Koerner Family Award in Civil, Architectural, and Environmental Engineering

Jacob Price 2014
Kaitlyn Sniffen 2015

Professor Wesley O. Pipes Environmental Engineering Student Award

Kaitlyn Sniffen 2014

UNIVERSITY SERVICE

Drexel Smart Initiatives Program (DSIP) Advisory Committee 2015-present
(COE Representative)

Institutional Advancement STEM/STEAM Advisory Board 2014-present
(Participant)

Drexel Navigator Program 2015-present
(Navigator)

Drexel Research Day 2013-2015
(Judge)

Drexel Open House Days 2013-2015
(Faculty Panelist)

PROFESSIONAL ACTIVITIES

Memberships

American Institute of Chemical Engineers since 2004
American Society for Microbiology since 2006
American Society of Civil Engineers since 2006
American Chemical Society since 2006
International Society for Microbial Ecology since 2010
Association of Environmental Engineering Science and Professors since 2013
Water Environment Federation since 2013

Service positions

Journal referee for: Applied Environmental Microbiology, BMC Genomics, Ecotoxicology and Environmental Safety, FEBS Journal, Nature Communications, Scientific Reports, Science of the Total Environment

Ad hoc reviewer: Army Research Office, Israel Science Foundation

Professional development

Problem Based Learning Workshop – Drexel University, Philadelphia, PA 2013

CAREER Workshop – AEEESP, Golden, CO	2013
Young and Aspiring Faculty Workshop – AEEESP, Golden, CO	
Academic Portfolio Workshop – Drexel University (DCAE), Philadelphia, PA	2015