EZRA L. CATES

Assistant Professor
Environmental Engineering and Earth Sciences
Clemson University
Rich Lab, 342 Computer Ct.
Anderson, SC 29625-6510

Phone: 864.656.1540
Email: ecates@clemson.edu

Education

- ***Georgia Institute of Technology, 2013***
  Ph.D. in Environmental Engineering
- ***University of North Carolina - Asheville (UNC-A), 2007***
  B.S. in Environmental Studies, with honors

Appointments

- Clemson University, Assistant Professor, Environmental Engineering, **2014-**
- Yale University, Postdoctoral Associate, Chemical and Environmental Engineering, **2013-2014**
- Environmental Quality Institute, UNC-A, Chemical Analyst, **2004-2008**
- Environmental Testing Solutions, Inc., Asheville, NC. Chemical Analyst, **2007-2008**
- North Carolina State University Water Quality Group. Field Technician, **2005-2008**

Affiliations

- Department of Environmental Engineering and Earth Sciences
- Center for Optical Materials Science and Engineering Technologies
- Clemson Water-Energy Consortium

Research Interests

- Light-activated materials for sustainable technology
- Photocatalytic advanced oxidation
- UVC-radioluminescent materials for X-ray based antibacterial strategies
- Radiocatalytic materials for advanced oxidation of water and wastewater
- Visible-to-UVC upconversion phosphors for antimicrobial surfaces
- Inorganic singlet oxygen photosensitizers for water/wastewater treatment and antimicrobial surfaces

Awards and Honors

2013 **Best Student Paper**, ACS National Meeting, Division of Environmental Chemistry (coauthor)

2011 **Best Environmental Technology Article of 2011**, *Environmental Science & Technology* (first author)
2011 **Best presentation**, Georgia Tech Environmental Engineering Research Internship Program (awarded to high school student mentees)
2010 **Best Student Paper**, ACS National Meeting, Division of Environmental Chemistry (first author)
2008 Georgia Power Fellowship in Environmental Engineering
2007 Environmental Studies Departmental Distinction (UNC-A)
2007 University Research Scholar (UNC-A)
2006 Environmental Quality Institute Research Assistantship (UNC-A)
2005 North Carolina Beautiful Fellowship in Pollution Control

Publications

1. Cates, E. L. and F. Li. **2016**. "Balancing intermediate state decay rates for efficient Pr^{3+} visible-to-UVC upconversion: the case of β-$Y_2Si_2O_7$:Pr^{3+}." RSC Advances **6**(27): 22791-22796.

2. Moor, K. J., Cates, E.L., Kim, J.H. **2016**. "Porous Silicon's Photoactivity in Water: Insights into Environmental Fate." ***Environmental Science & Technology.*** 50(2): 756-764.

3. Cates, E. L. and J.H. Kim. **2015**. "Bench-scale evaluation of water disinfection by visible-to-UVC upconversion under high-intensity irradiation." ***Journal of Photochemistry and Photobiology B: Biology,*** 153: 405-411.

4. Cates, E. L. **2015**. "Comment on "Intimate Coupling of Photocatalysis and Biodegradation for Degrading Phenol Using Different Light Types: Visible Light vs UV Light"." ***Environmental Science & Technology*** 49(21): 13075-13076.

5. Cates, E.L., A.P. Wilkinson, J.H. Kim. **2015**. "Visible-to-UVC upconversion efficiency and mechanisms in $Lu_7O_6F_9$:Pr^{3+} and Y_2SiO_5:Pr^{3+} ceramics". ***Journal of Luminescence,***160(2015) p. 202-209.

6. Park, G.W., M. Cho, E.L. Cates, J.H. Kim, D. Lee, B.T. Oh, J. Vinjé. **2014**. "Evaluation of fluorinated TiO_2 as an ambient light-activated antimicrobial surface for control of human norovirus". ***Journal of Photochemistry and Photobiology B.*** 140(0): 315-320.

7. Cates, S.L., E.L. Cates, M. Cho, J.H. Kim. **2014**. "Synthesis and characterization of visible-to-UVC upconversion antimicrobial ceramics". ***Environmental Science & Technology***, 48(4) p. 2290-2297.

8. Cates, E.L., J.H. Kim. **2013.** "Upconversion under polychromatic excitation: Y_2SiO_5:Pr^{3+},Li^{+} converts violet, cyan, green, and yellow light into UVC." ***Optical Materials***, 35(12) p. 2347-2351.

9. Cates, E.L., S.L. Chinnapongse, J.H. Kim, J.H. Kim. **2012**. "Engineering light: Advances in wavelength conversion materials for energy and environmental technology (Critical Review)". ***Environmental Science & Technology***, 46(22) p. 12316-12328.

10. Cates, E.L., A.P. Wilkinson, J.H. Kim. **2012**. "Delineating mechanisms of upconversion enhancement by Li^{+} doping in $Y_2SiO_5:Pr^{3+}$". ***Journal of Physical Chemistry C***, 116(23) p. 12772-12778.

11. Cates, E.L., M. Cho, J.H. Kim. **2011**. "Converting visible light into UVC: Microbial inactivation by Pr^{3+}-activated upconversion materials". ***Environmental Science & Technology***, 45(8) p. 3680 – 3686.

12. Cho, M., E.L. Cates, and J.H. Kim. **2011** "Inactivation and surface interactions of MS-2 bacteriophage in a TiO_2 photoelectrocatalytic reactor". ***Water Research***, 45(5) p. 2104 – 2110.

13. Cates, E.L., S. Patch, J. Cox, M. Westphal, J. Calabria. **2009**. "Field evaluation of a proprietary stormwater treatment system: Removal efficiency and relationships to peak flow, season, and dry time". ***ASCE Journal of Environmental Engineering***, 135(7) p. 511-517.

Patents

(Applied for and pending)

1. Cates, E.L. "Materials and methods for reducing biofouling in water treatment membrane systems". Non-provisional, U.S.A.

2. Kim, J.H.; Cates, E.L.; Cho, M. "Method for Microbial Inactivation and Inhibition using Ultraviolet-Emitting Upconversion Luminescence", applied for in US (US12/785.207), Korea, Japan, and China.

Funding

1. NSF EAGER Program, CBET - 1551534, $64,214. "UVC microbial inactivation within model water treatment membrane modules via X-ray-driven radioluminescence". Sep. 2015 – 2016.

2. New Faculty Startup package, Department of Environmental Engineering and Earth Sciences, College of Engineering and Science, Clemson University. Aug. 2014

Presentations

1. Cates, E.L. (Invited). "Boldly going where no UV has gone before: Producing UVC inside membrane modules using X-ray radioluminescence". Environmental engineering graduate seminar series, Vanderbilt University, Nasheville, TN.
2. Cates, E.L., Johson, T.A., Ladner, D.A., Rehak, E. "Boldly going where no UV has gone before: Producing UVC inside membrane modules using X-ray radioluminescence". International Ultraviolet Association World Congress, Vancouver, B.C. (Feb. 2016)
3. Cates, E.L., S. Sahu, T.A. Johnson. "Radiocatalytic materials for pursuing fixed-bed heterogeneous advanced oxidation using X-rays". American Chemical Society National Meeting, Boston (August 2015).

4. T.A. Johnson, E.L. Cates. “Radioluminescence membrane biofouling control (RMBC): Material development for producing germicidal UV radiation inside membrane modules using X-rays”
5. Cates, E.L.. “Exploring the use of X-ray excited radiocatalysts and radioluminescent materials in environmental technologies”. Association of Environmental Engineering and Science Professors National Meeting, New Haven, CT (June 2015).
6. Cates, E.L., F. Li, T.A. Johnson.“Research towards radiocatalysts for X-ray driven advanced oxidation”. American Chemical Society National Meeting, Denver (April 2015)
7. Cates, E.L., “Lessons from the academic job search”. UNC-Chapel Hill Environmental Science and Engineering “Learning and Libations” series. Invited. (Nov. 2014)
8. Cates, E.L., K.J. Moor, J.H. Kim.“Microbial inhibition through singlet oxygen photosensitization by silicon nanocrystals”. American Chemical Society Nation Meeting, Dallas (March 2014**)**.
9. Cates, E.L., A.P. Wilkinson, J.H. Kim “New host crystal systems for improved antimicrobial visible-to-UVC upconversion phosphors”. American Chemical Society National Meeting. New Orleans (April 2013).
10. Cates, E.L., A.P. Wilkinson, J.H. Kim “Oxyfluoride Host Crystals for Efficient Visible-to-UVC Upconversion by Pr^{3+}”. Materials Research Society National Meeting. San Francisco (April 2013).
11. Cates, E.L., A.P. Wilkinson, J.H. Kim “Visible-to-ultraviolet upconversion materials for light-activated antimicrobial surfaces”. Georgia Tech Research and Innovation Conference. Atlanta (Feb. 2013).
12. Cates, E.L., A.P. Wilkinson, J.H. Kim “Delineating mechanisms of upconversion enhancement by Li^+ codoping in $Y_2SiO_5:Pr^{3+}$”. Materials Research Society National Meeting. San Francisco (April 2012**)**.
13. Cates, E.L., A.P. Wilkinson, J.H. Kim.“Delineating Optical Enhancment Mechanisms by Li^+ Ions in the Antimicrobial Upconversion Material $Y_2SiO_5:Pr^{3+}$”. American Chemical Society National Meeting. San Diego (March 2012).
14. Cates, E.L., M. Cho, J.H. Kim. “Converting visible light to UVC: Lanthanide upconversion nano-phosphors for light-activated biocidal surfaces”. American Chemical Society National Meeting. Boston (Aug. 2010).
15. Cates, E.L., M.J. Westphal, J.A. Calabria, S. Patch. “Stormwater pollutant removal efficiency by a proprietary treatment system in Western North Carolina”. Water Resources Research Institute Annual Conference. Raleigh, NC, (Jane 2007).
16. Cates, E.L., M.J. Westphal, J.A. Calabria, S. Patch. “Stormwater pollutant removal efficiency by a proprietary treatment system in Western North Carolina”. Big South Undergraduate Research Symposium. Conway, SC (Feb 2007).

Memberships

- American Chemical Society, Division of Environmental Chemistry
- Association of Environmental Engineering and Science Professors

Consulting

- Design of UVC sterilization device. Global Center for Medical Innovation.

Teaching

- EES 8030, Physicochemical Operations in Water and Wastewater Treatment Systems
- EES 8050, Physicochemical Operations Laboratory
- EES 8610, 9610 Environmental Engineering and Science Seminar

Service

- Member, Membership and Demographics Committee, Association of Environmental Engineering and Science Professors