

# James Dylan Rees

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## Summary

I am a postdoctoral researcher working at Rensselaer Polytechnic Institute in Troy, NY through the Darrin Fresh Water Institute. My research combines microbiology with semiconductor, device, sensor, and materials engineering. One of my major research projects focuses on growing dissimilatory metal-reducing bacteria under anaerobic conditions, utilizing their "metal-breathing" capabilities to bio-assemble semiconductor nanomaterials. The goal of this work is to explore how these bio-assembly methods can offer advantages in semiconductor device manufacture such as room-temperature synthesis, controllability, novel nanostructures, bio-passivation, and the ability to combine wastewater treatment with electronics manufacturing. I am also interested in studying how biofilms of bacteria and other microorganisms respond to environmental changes at biofilm-electrode interfaces. The goal of studying such interfaces is to engineer biosensors capable of converting microbial processes into electric current, enabling new and versatile methods of environmental sensing.

Beyond my technical work, I am interested in using my engineering research as a context for work at the borderline between engineering and the humanities. My non-technical interests include citizen science, STEM education, and feminist/decolonial research methodologies and epistemologies. I am an active member of the Society for the Social Studies of Science, where I have participated in panels and workshops and collaborated with researchers in Science and Technology Studies.

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## Education

### Rensselaer Polytechnic Institute

August 2012 - May 2019

PhD, Electrical Engineering

*Thesis Title: "Shewanella oneidensis MR-1 as an avenue for green nanoparticle biosynthesis and next-generation biosensing" (Advisors: Prof. Shayla Sawyer, Prof. Yuri Gorby)*

### Rensselaer Polytechnic Institute

August 2012 - May 2017

Master of Science, Electrical Engineering

### Oberlin College

August 2007 - May 2011

Bachelor of Arts, Physics

Cumulative GPA: 3.62

*John F. Oberlin Scholarship*

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## Research Experience

### Rensselaer Polytechnic Institute Troy, NY

September 2019 - Present

*Postdoctoral Scholar, Darrin Fresh Water Institute*

Continued prior work on novel nanomaterial synthesis using *Shewanella*, leading a small team that included one graduate student and two undergraduate students. Explored the use of bacterially-synthesized nanomaterials in semiconductor device manufacture. Collected bacterial samples from freshwater ecosystems and characterized their solid, liquid and gas-phase metabolic products under controlled conditions. Explored the feasibility of bacteria-based electrochemical biosensors for environmental sensing applications. Collaborated with three RPI professors on the conceptualization, writing and submission of a \$1.5 million NSF proposal titled "SemiSynBio-II: Hybrid bioelectronic data storage: Synthetic biology-enabled distributed computation and readout".

**Rensselaer Polytechnic Institute** Troy, NY

June 2016 - May 2019

*PhD Thesis Project*

Synthesized and characterized novel semiconductor nanomaterials using *Shewanella oneidensis* MR-1. Performed electrochemical characterization of *Shewanella* biofilms in an aqueous medium.

**Rensselaer Polytechnic Institute** Troy, NY

June 2016 - August 2016

*Summer Research Fellow, GK-12 Project*

Designed and built a photogate-based jump height measurement tool for classroom sports science demonstrations. Led workshops with K-12 students and teachers on RFID chips and the use of e-waste in design.

**Rensselaer Polytechnic Institute** Troy, NY

August 2014 - May 2016

*Research Assistant*

Performed rapid single-flux quantum (RSFQ) digital circuit design. Tasks included the development of parameterizable physical models of circuit components and the creation of a hardware description language (HDL) for design verification.

**Oberlin College** Oberlin, OH

August 2010 - November 2011

*Undergraduate Researcher*

Designed and built an experimental airborne wind turbine designed to be suspended from a weather balloon and a series of cables at a height of 500 feet. Worked with the Federal Aviation Administration (FAA) to secure launch permissions at a test site near Oberlin, OH, then conducted a test launch of the turbine.

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## Skills

### Biology and Chemistry Lab Techniques

- Bacterial Cultivation
- Wet Chemistry / Bench Chemistry
- Confocal Microscopy
- Cyclic Voltammetry
- Electrochemical Impedance Spectroscopy

### Materials Characterization

- Scanning Electron Microscopy
- Energy-Dispersive X-Ray Spectroscopy
- Transmission Electron Microscopy
- UV and Visible-Light Spectrophotometry
- Raman Spectroscopy
- X-Ray Crystallography

### Semiconductor Device Fabrication and Modeling

- Shipley 1813 Positive Photolithography Process
- Taurus Medici 2D Device Simulator

### Digital Circuit Design & Testing

- Cadence Virtuoso
- Integrated Cryogenic Electronics Test Bed (ICE-T)
- Hardware Description Languages (Verilog, VHDL)

### Other Computer Skills

- C / C++
- JavaScript

- Python
- Git / GitHub
- MATLAB
- GNU/Linux
- BSD

### Languages Spoken

- English (fluent)
- Spanish (fluent)
- German (moderate proficiency)

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## Publications

*Pending review:*

J. D. Rees, Y.A. Gorby, and S. Sawyer, "Characterization and biosynthesis of molybdenum disulfide nanoparticles at *Shewanella oneidensis* MR-1 biofilm surfaces", *AVS Biointerphases*, Submitted March 2020.

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## Teaching Experience

**Rensselaer Polytechnic Institute** Troy, NY

*Teaching Assistant*

### Courses Taught:

- [1] Electronic Instrumentation (ENGR 2300), Fall 2012 - Spring 2014, Fall 2018, *approx. 120 students*
- [2] Fields & Waves 1 (ECSE 2100), Fall 2012 - Spring 2014, *approx. 50 students*
- [3] Introduction to Logic (PHIL 2140), Fall 2016, Fall 2017, *approx. 100 students*
- [4] Law, Values and Public Policy (STSS 2350), Spring 2017, *approx. 40 students*
- [5] Cognitive Modeling (PSYC 4510), Spring 2018, *approx. 30 students*
- [6] Introduction to Philosophy (PHIL 1110), Spring 2018, *approx. 100 students*
- [7] Electric Circuits (ECSE 2010), Fall 2018, *approx. 100 students*

**Washington State Community College** Marietta, OH

October 2011 - June 2012

*Learning Center Tutor*

Tutored students in one-on-one and group settings in basic math, algebra, precalculus, calculus, chemistry, and physics. Operated a drop-in daytime tutoring center for community college students.

**Marietta City Schools** Marietta, OH

August 2011 - December 2011

*Substitute Teacher*

Taught K-12 students from ages 5-18 in a wide range of subjects including math, chemistry, biology, earth science, and English

**Washington County Juvenile Center**

August 2011 - December 2011

*Tutor*

Tutored low-level juvenile offenders from ages 12-18. Subjects included mathematics, English, and general science. Curricula also included the building of study skills, test-taking strategies, and other remedial academic instruction.

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## Professional and Public Lectures

### Invited Talks

- [1] "Worms in Urban Ecology", RPI ARTS 4965 (Biopunk: Arts Lab Practice), November 2019.
- [2] "A Background on Rojava", RPI PHIL 2960 (Anarchism: Ethical Society), April 2017.
- [3] "Fake News and Media Polarization", RPI STSS 2350 (Law, Values and Public Policy), March 2017.
- [4] "Citizen Science from an Engineer's Perspective", RPI Science and Technology Studies Brown Bag, May 2016.
- [5] "Cultivating Kombucha and Slime Mold", RPI STSH 4610 (PDI Design Studio 5), August 2016.

## **Conference Talks**

- [1] "Engineering with trickster microorganisms and their assemblages." *Northeast STS Graduate Student Conference*. Troy, NY. March 6-7, 2020.
- [2] "Streak plating and silicon: An STS re-examining of engineering from within the discipline." *4S Annual Meeting*, New Orleans, LA. September 4-7, 2019.
- [3] "Biosynthesis of molybdenum disulfide nanoparticles using the metal-reducing bacterium *Shewanella oneidensis* MR-1." *61st Electronic Materials Conference*, Ann Arbor, MI. June 26-28, 2019.
- [4] "Behavior of *Shewanella oneidensis* MR-1 in a sulfur and zinc-rich medium and its applications for biosensing and biomaterials." *AVS Pacific Rim Symposium on Surfaces, Coatings and Interfaces*, Waikaloa, HI. December 2-6, 2018.
- [5] "Behavior of *Shewanella oneidensis* MR-1 in a sulfur and zinc-rich medium and its applications for biosensing and biomaterials." *2018 IEEE Nanotechnology Symposium*, Albany, NY. November 14, 2018.
- [6] "Making citizen science through doing citizen science," *4S Annual Meeting*. Boston, NY. August 31, 2017.
- [7] "Citizen Science from an Engineer's Perspective." *Northeast STS Graduate Student Conference*. Troy, NY. March 2016.

## **Community and Public Service Panels and Talks**

- [1] "Bacteria as Nano-Engineers", RPI 3-Minute Thesis Competition, April 2019
- [2] "Introduction to Aquaponics", NATURE Lab Workshop Series, Sanctuary for Independent Media, December 2018
- [3] "Rojava: Political Technologies and the Failure of Our Imagination", 'Magic Valley' education retreat, Margaretville, NY. May 2017
- [4] "Mountaintop Removal Mining", Summer Service Series, First Unitarian Universalist Church of Marietta Ohio, June 2011.

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## **Service and Administration Activities**

- Poster Judge, RPI CMDIS Annual Research Symposium, December 2019
- President, Oberlin Student Cooperative Association, June 2010 - June 2011
- OSCA/Oberlin College Liaison, Oberlin Student Cooperative Association, June 2009 - June 2010

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## **Professional Affiliations**

- Institute of Electrical and Electronics Engineers (IEEE)
- Society for the Social Studies of Science (4S)

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## **Awards**

- 2019 RPI Three-Minute Thesis Competition Finalist
  - 2017 Link Foundation Energy Fellowship - Honorable Mention
  - 2010 Oberlin Green EDGE Fellowship Grant
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## **Patents**

*Provisional:* J. D. Rees and S. Sawyer, "Bacteria-Permeated Field Effect Transistor for Sensing Applications", September 2018.