James E. Rainbolt, Ph.D.

james.rainbolt@gmail.com
rainbolt@gonzaga.edu

SUMMARY: College lecturer, physical organic chemistry and organic synthesis as well as experience with chemical engineering. My academic interests include weak non-covalent interactions, extended conjugated systems, aromaticity and anti-aromaticity.

GONZAGA UNIVERSITY
LECTURER-AT August 2017 – current

Academic Duties

- Lecturer for CHEM101: General Chemistry, designed for chemistry, biochemistry, biology, engineering, nursing, and human physiology majors.
- Design and assign problem sets, quizzes, and exams to gauge student understanding.
- Instructor for CHEM101L general chemistry laboratory section(s).
- Instructor for CHEM230L organic chemistry laboratory section(s).
- Member of Chemistry and Biochemistry Curriculum Task Force, Fall 2017, commissioned to revise, and create new, career development courses for Chem/Biochem majors.

WENATCHEE VALLEY COLLEGE
Adjunct Professor of Science June 2016 – August 2016

Academic Duties

- Lecturer for CHEM 121: Introduction to Chemistry
- Generate original lecture notes and materials for daily instruction.
- Design and assign original problem sets and exams
- Teach the associated laboratory section CHEM121L.

PACIFIC NORTHWEST NATIONAL LABORATORY
Postdoctoral Researcher May 2008- April 2011
Promoted to Research Scientist II April 2011- April 2014

Research Achievements:

- Synthesized a new anchored *p*-type conductivity dopant for organic light emitting diodes (OLEDs). Demonstrated that substitution of a known dopant with an anchoring arm does not negatively impact doping capability. Wrote/first author on publication.
- Developed and scaled up the synthesis of ambipolar (i.e., both hole and electron conducting) materials for OLEDs.
- Planned and synthesized a bis-triazinylpyridine chelating ligand for research in selective lanthanide/actinide separations.
- First to demonstrate that tertiary amines bearing alcohol functionality absorb CO_2 at elevated pressure to form zwitterionic organic liquids, and release CO_2 upon depressurization with 100% regenerative yield, as part of a larger carbon-capture project. Wrote/first author on publication, accepted without corrections.
- Lead researcher for hot syngas cleanup project, sulfur removal. Revealed the relationship between temperature, stream, gas composition and sulfur source on ZnO uptake capacity.
- Successful completion of onsite 50-hour coal gas cleanup demonstration at the Western Research Institute in Laramie, WY.

- Demonstrated full biomass-to-hydrogen conversion, by hydrolysis/deconstruction of cornstover to ethylene glycol (EG) using WO_3/Al_2O_3 and subsequent reforming of EG to hydrogen using a Pt/Re on ZrO_2 catalyst.

Research Expertise:

- **Synthetic and Physical Organic Chemistry**: Small molecule organic synthesis expertise. Experience with HOMO/LUMO energy level calculations from cyclic voltammetry. Gibbs free energy calculation of an unusual 6-membered ring flip.
- **Chemical Instrumentation**: Characterization using Varian NMR, including variable-temperature NMR and NOESY1D spectroscopy; XRD, BET, Cyclic Voltammetry, UV-Vis, and FT-IR; Gas chromatography and detectors, including GCMS, GCxGC-TOFMS, GC-PDHID and GC-SCD.
- **Chemical Engineering**: Catalytic/sorbent purification and characterization of coal gas (syngas), with a focus on H_2S, PH_3 and ASH_3 removal; biomass-to-hydrogen conversion via deconstruction/reduction to ethylene glycol and subsequent aqueous phase reforming.

EDUCATION

Ph.D. in Organic Chemistry, University of New Hampshire with Glen Miller – Durham, New Hampshire, September 2002- December 2007. Ph.D. Dissertation: "Probing CH/pi-orbital Interactions: Regioselectivity in the Diels-Alder Cycloadditions between Phenyl-Substituted Acenes and [60]Fullerene."

PATENTS

System and Process for Capture of H_2S From Gaseous Process Streams and Process for Regeneration of the Capture Agent." David J. Heldebrant, Phillip K. Koech, James E. Rainbolt, Mark D. Bearden, Feng Zheng. Battelle Memorial Institute. Patent Number US 8,652,237 B2. *Granted, Feb. 18, 2014.*

"System and Process for Capture of Acid Gasses at Elevated Pressure From Gaseous Process Streams." James E. Rainbolt, David J. Heldebrant, Phillip K. Koech, John C. Linehan, Mark D. Bearden, Feng Zheng. Battelle Memorial Institute. US 20120061613 A1, *Application.*

SELECT PUBLICATIONS (of 20+ total)

"Warm Cleanup of Coal Derived Syngas: Multi-contaminant Removal Process Demonstration." Spies, K. A.; Rainbolt, J. E.; Li, X. S.; Braunberger, B.; Li, L.; King, D. L.; Dagle, R. A. *Energy Fuels* **2017**, *31*, 2448-2456.

"Hierarchically structured catalysts for cascade and selective steam reforming/ hydrodeoxygenation reactions" Sun, J.; Karim, A.M., Li, X.; Rainbolt, J.; Kovarik, L.; Shin, Y.; Wang, Y. *Chem. Commun.* **2015**, *51*, 16617-16620.

"Synthesis and Characterization of P-type Conductivity Dopant 2-(3-(adamantan-1-yl)propyl)-3,5,6-trifluoro-7,7,8,8-tetracyanoquinodimethane." **Rainbolt, J. E**.; Koech, P.; Swensen, J.; Polikarpov, E.; Von Ruden, A.; Wang, L.; Sapochak, L.; Padmaperuma, A.; Gaspar, D. *J. Mater. Chem. C* **2013**, *9*, 1876-1884.

"Progress Toward Biomass and Coal-derived Syngas Arm Cleanup: Proof-of-concept Process Demonstration of Multicontaminant Removal of Biomass Application." Howard, C. J.; Dagle, R. A.; Lebarbier, V. M. C.; Rainbolt, J. E.; Li, L.; and King, D. L. *Ind. Eng. Chem. Res.* **2013***, 52*(24), 8125-8138.

"Near Independence of OLED Operating Voltage on Transport Layer Thickness." Swensen, J. S.; Wang, L.; Polikarpov, E.; Rainbolt, J. E.; Koech, P. K.; Cosimbescu, L.; Padmaperuma, A. B. *Synth. Met.* **2013**, *163*, 29-32.

"Characterization of Solution Processed, P-doped Films Using Hole-only Devices and Organic Field-effect Transistors." Swensen, J. S.; Wang, L.; Rainbolt, J. E.; Koech, P. K.; Polikarpov, E.; Gaspar, D. J.; Padmaperuma, A. B. *Org. Electron.* **2012**, *13*(12), 3085-3090.

"Anhydrous Tertiary Alkanolamines as Hybrid Chemical and Physical CO_2 Capture Reagents with Pressure-swing Regeneration." **Rainbolt, J. E**.; Koech, P. K.; Yonker, C. R.; Zheng, F.; Main, D.; Weaver, M. L.; Linehan, J. C.; Heldebrant, D. J. *Energy Environ. Sci.* **2011**, *4*, 480. (Manuscript written by me and accepted as-is).

"Performance of Single-component CO_2-binding Organic Liquids (CO_2BOLs) for Post Combustion CO_2 capture." Heldebrant, D. J.; Koech, P. K.; Rainbolt, J. E.; Zheng, F.; Smurthwaite, T.; Oss, M.; Leito, I. *J. Chem. Eng.* **2011**, *171,* 794.

"Chemically Selective Gas Sweetening Without Thermal-swing Regeneration." Koech, P.K.; Rainbolt, J. E.; Bearden, M. D.; Zheng, F.; Heldebrant, D. J. *Energy Environ. Sci.* **2011**, *4*, 1385-1390.

"Controlling Charge Transport in Blue Organic Light-emitting Devices by Chemical Functionalization of Host Materials." Polikarpov, E.; Koech, P. K.; Wang, L.; Swensen, J. S.; Cosimbescu, L.; Rainbolt, J. E., Von Ruden, A. L.; Gaspar, D. J.; Padmaperuma, A. B. *J. Photonics Energy (SPIE),* **2011**, *1*, 011007-1.

"Blue Phosphorescent Organic Light-emitting Devices Utilizing Cesium–carbonate-doped 2,4,6-tris(2,4-difluoro-[1,1-biphenyl]-4-yl)-1,3,5-triazine." Swensen, J.; Rainbolt, J. E.; Wang, L.; Koech, P.; Polikarpov, E.; Padmaperuma, A.; Gaspar, D. J. *Photonics Energy (SPIE)* **2011**, *1*, 011008-1.

"Synthesis and Application of Pyridine-based Ambipolar Hosts: Control of Charge Balance in Organic Light Emitting Devices by Chemical Structure Modification." Koech, P. K.; Polikarpov, E.; Rainbolt, J. E.; Cosimbescu, L.; Swensen, J. S.; Von Ruden, A. L.; Padmaperuma, A. B.; *Org. Lett.* **2010**, *12*, 5534.

"Synthesis and Application of 1,3,4,5,7,8-hexafluorotetracyanonapthaquinodimethane (F6-TNAP): A Conductivity Dopant for Organic Light Emitting Devices." Koech, P. K.; Padmaperuma, A. B.; Wang, L.; Swensen, J. S.; Polikarpov, E.; Darsell, J. T. ; Rainbolt, J. E.; Gaspar, D. J. *Chem. Mater.* **2010**, *22,* 3926.

"Reversible Zwitterionic Liquids, the Reaction of Alkanol Guanidines, Alkanol Amidines, and Diamines with CO_2." Heldebrant, D. J.; Koech, P. K.; Ang, T.; Liang, C.; Rainbolt, J. E.; Yonker, C. R.; Jessop, P. G. *Green Chem.* **2010**, *12,* 713.

"Emission Zone Control in Blue Organic Electrophosphorescent Devices Through Chemical Modification of Host Materials." Polikarpov, E.; Swensen, J. S.; Cosimbescu, L.; Koech, P. K.; Rainbolt, J. E.; Padmaperuma, A. B. *Appl. Phys. Lett.* **2010**, *96*, 053306.

"4,7-Diphenylisobenzofuran: A Useful Intermediate for the Construction of Phenyl-Substituted Acenes." **Rainbolt, J. E.**; Miller, G. P. *J. Org. Chem.* **2007**, *72,* 3020-3030.