

# Ross P. Carlson

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## Education:

<u>Ph.D. Chemical Engineering</u>	2003
University of Minnesota, Twin Cities	
<u>M.S. Microbial Engineering</u>	1998
University of Minnesota, Twin Cities	
<u>B.S. Biochemistry <i>magna cum laude</i></u>	1996
University of Minnesota, Twin Cities	

## Professional Positions:

<u>Professor</u> , Department of Chemical and Biological Engineering	2016-
Montana State University, Bozeman	
<u>Associate Professor</u> , Department of Chemical and Biological Engineering	2011-2016
Montana State University, Bozeman	
<u>Assistant Professor</u> , Department of Chemical and Biological Engineering	2005-2011
Montana State University, Bozeman	
<u>Post-Doctoral Research Associate</u> , P. Stewart Laboratory	2004-2005
Center for Biofilm Engineering, Montana State University, Bozeman	
<u>Post-Doctoral Research Associate</u> , F. Srienc & A. Khodursky Laboratories	2003-2004
University of Minnesota, Twin Cities	
<u>Graduate Research Assistant, Ph.D./M.S.</u> , F. Srienc Laboratory	1996-2003
University of Minnesota, Twin Cities	
<u>Fermentation/Bioreactor Technician</u> , BioTechnology Institute Pilot Plant	1996
University of Minnesota, Twin Cities	

## Awards:

- MSU College of Engineering Award for Excellence in Teaching: 2015.
- Center for Biofilm Engineering Researcher of the Year: 2012.
- MSU Merit Award: 2011, 2012, 2014, 2015.
- MSU Award for Excellence: 2010, 2013, 2016.
- MSU College of Engineering Award for Excellence in Research: 2010.
- MSU President's Excellence in Teaching Award, student nomination: 2009, 2014.

## Research Activities:

### Publications, peer-reviewed and invited submissions (49 total)

1. Hunt, K.A., deM Jennings, R., Inskeep, W.P., Carlson, R.P. (2016) Stoichiometric modelling of assimilatory and dissimilatory biomass utilization in a microbial community. *Environmental Microbiology*. *In press*.

2. Carlson, R.P., Oshota, O., Shipman, M., Caserta, J.A., Hu, P., Saunders, C.W., Xu, J., Reeder, N., Richards, A., Pettigrew, C., Peyton, B.M. (2016) Integrated molecular, physiological and in silico characterization of two *Halomonas* isolates from industrial brine. *Extremophiles*. *In press*.
3. Phalak, P., Chen, J., Carlson, R.P., Henson, M.A. (2016) Metabolic Modeling of a Chronic Wound Biofilm Consortium Predicts Spatial Partitioning of Bacterial Species. Phalak, P., Chen, J., Carlson, R.P., Henson, M.A. *BMC Systems Biology*. *In press*.
4. Beck, A., Hunt, K.A., Bernstein, H.C., Carlson, R.P. (2016) Interpreting and designing microbial communities for bioprocess applications, from components to interactions to emergent properties. *Biotechnologies for Biofuel Production and Optimization*. 1: 407-432.
5. Folsom, J.P., Carlson R.P. (2015) Physiological, elemental composition, and proteomic analyses of *Escherichia coli* ammonium-limited chemostat growth with comparison to iron- and glucose-limited chemostat growth. *Microbiology*. 161: 1659-1970.
6. Singh, D., Carlson, R.P., Fell, D.A., Poolman, M. (2015) Modelling metabolism of the diatom *Phaeodactylum tricornutum*. *Biochemical transactions*. **43**(6): 1182-1186.
7. Folsom, J.P., Parker, A., Carlson, R.P. (2014) Physiological and Proteomic Analysis of *Escherichia coli* Iron-Limited Chemostat Growth. *Journal of Bacteriology*. 196: 2748-2763.
8. Ammons, M.C.B., Tripet, B.P., Carlson, R.P., Kirker, K.R., Gross, M.A., Stanisich, J.J., Copié V. (2014) Quantitative NMR Metabolite Profiling of Methicillin-Resistant and Methicillin-Susceptible *Staphylococcus aureus* Discriminates between Biofilm and Planktonic Phenotypes. *Journal of Proteome Research*. 13(6): 2973-2985.
9. Hunt, K.A., Folsom, J.P., Taffs, R.L., Carlson, R.P. (2014) Complete enumeration of elementary flux modes through scalable demand-based subnetwork definition. *Bioinformatics*. 30: 1569-1578.
10. Bernstein, H.C., Carlson, R.P. (2014) Design, construction and characterization methodologies for synthetic microbial consortia. *Methods in Molecular Biology*. 1151: 49-68.
11. Mallette, N., Pankratz, E.M., Parker, A.E., Strobel, G.A., Busse, S.C., Carlson, R.P., Peyton, B.M. (2014) Evaluation of Cellulose as a Substrate for Hydrocarbon Fuel Production by *Ascocoryne sarcoides* (NRRL 50072). *Journal of Sustainable Bioenergy Systems*. 4(1): ID 44247.
12. Bernstein, H.C., Kesaano, M., Moll, K., Smith, T., Gerlach, R., Carlson, R.P., Miller, C.D., Peyton, B.M., Cooksey, K.E., Gardner, R.D., Sims, R.C. (2014) Direct measurement and characterization of active photosynthesis zones inside wastewater remediateing and biofuel producing microalgal biofilms. *Bioresource Technology*. 156: 206-215.
13. Bhardwaj, C., Moore, J.F., Cui, Y., Gasper, G., Bernstein, H.C., Carlson, R.P., Hanley, L. (2013) Laser desorption VUV postionization MS imaging of a cocultured biofilm. *Analytical and Bioanalytical Chemistry*. 405: 6969-6977.
14. Bernstein, H.C., Beam J.P., Kozubal, M.A., Carlson, R. P., Inskeep, W.P. (2013) *In situ* Analysis of Oxygen Consumption and Diffusive Transport in High-temperature Acidic Iron Oxide Mats. *Environmental Microbiology*. 15: 2360-2370.
15. Bhardwaj, C., Cui, Y., Hofstetter, T., Liu, S.Y., Bernstein, H.C., Carlson, R.P., Ahmed, M., Hanley, L. (2013) Differentiation of microbial species and strains in coculture biofilms by multivariate analysis of laser desorption postionization mass spectra. *Analyst*. 138: 6844-6851.
16. Valenzuela, J., Carlson, R.P., Gerlach, R., Cooksey, K., Peyton, B.M., Bothner, B., Fields, M.W. (2013) Nutrient resupplementation arrest bio-oil accumulation in *Phaeodactylum tricornutum*. *Applied Microbiology and Biotechnology*. 97: 7049-7059.
17. Cui, Y., Bhardwaj, C., Milasinovic, S., Carlson, R.P., Gordon, R.j., Hanley, L. (2013) Molecular imaging and depth profiling of biomaterials interfaces by femtosecond laser desorption postionization mass spectrometry. *Applied Materials and Interfaces*. 5: 9269-9275.
18. Mus, F., Toussaint, J.P., Cooksey, K.E., Fields, M.W., Gerlach, R., Peyton, B.M., Carlson, R.P. (2013) Physiological and Molecular Analysis of Carbon Source Supplementation and pH Stress Induced Lipid

- Accumulation in the Marine Diatom *Phaeodactylum tricorutum*. *Applied Microbiology and Biotechnology*. 97: 3625-3642.
19. Bernstein, H., Carlson, R.P. (2012) Microbial Consortia Engineering for Cellular Factories: *in vitro* to *in silico*. *Computational and Structural Biotechnology Journal* 3(4) e201210017.
  20. Carlson, R.P., Oshota, O.J., Taffs, R. (2012) Systems analysis of microbial adaptations to simultaneous stresses. *Subcellular Biochemistry*. 64: 139-157.
  21. Blaze, M.T., Ayin, B., Carlson, R., Hanley, L. (2012) Identification and Imaging of Peptides and Proteins on *Enterococcus faecalis* Biofilms by Matrix Assisted Laser Desorption Ionization Mass Spectrometry. *Analyst*. 137: 5018. .
  22. Mallette, N., Knighton, W.B., Strobel, G.A., Carlson, R.P., Peyton B.M. (2012) Resolution of volatile fuel compound profiles from *Ascocoryne sarcoïdes*: a comparison by proton transfer reaction-mass spectrometry and solid phase microextraction gas chromatography-mass spectrometry. *AMB Express*. 2:23.
  23. Valenzuela, J., Mazurie, A., Carlson, R.P., Gerlach, R., Cooksey, K., Peyton, B.M., Fields, M.W. (2012) Potential role of multiple carbon fixation pathways during lipid accumulation in *Phaeodactylum tricorutum*. *Biotechnology for Biofuels* 5:40.
  24. Bernstein, H., Paulson, S., Carlson, R.P. (2012) Synthetic *Escherichia coli* consortia engineered for syntrophy demonstrate enhanced biomass productivity. *Journal of Biotechnology*, 157: 159-166.
  25. Gardner, R., Cooksey, K. Mus, F., Macur, R., Moll, K., Eustance, E., Carlson, R.P. Gerlach, R., Fields, M.W., Peyton, B.M. (2012) Use of Sodium Bicarbonate to Stimulate Triacylglycerol Accumulation in the Chlorophyte *Scenedesmus* sp. and the diatom *Phaeodactylum tricorutum*. *Journal of Applied Phycology*. 24: 1311-1320.
  26. El-Mansi, M., Stephanopoulos, G., Carlson, R.P. (2011) Chapter 7: Flux Control Analysis and Stoichiometric Network Modeling: Basic Principles and Industrial Applications. *Fermentation Microbiology and Biotechnology* pp. 165-190. (eds M. El-Mansi, C.F.A. Bryce, A.L. Demain, A.R. Allman) CRC/Taylor and Francis Inc.
  27. Carlson, R.P., Taffs, R.L. (2010) Molecular-level tradeoffs and metabolic adaptations to simultaneous stressors. *Current Opinion in Biotechnology*. 21: 1-7.
  28. Zuroff, T., Bernstein, H., Llyod-Randolfi, J., Jimenez-Taracido, L., Stewart, P.S., Carlson, R.P. (2010) Robustness analysis of culturing perturbations on *Escherichia coli* colony biofilm beta-lactam and aminoglycoside antibiotic tolerance. *BMC Microbiology*. 10: 185.
  29. Taffs, R., Aston, J.E., Brileya, K., Jay, Z., Klatt, C.G., McGlynn, S., Mallette, N., Montross, S., Gerlach, R., Inskip, W.P., Ward, D.M., Carlson R.P. (2009) *In silico* approaches to study mass and energy flows in microbial consortia: a syntrophic case study. *BMC Systems Biology* 3:114.
  30. Carlson, R.P. (2009) Decomposition of complex microbial behaviors into resource-based stresses. *Bioinformatics*. 25: 90-97.
  31. Carlson, R.P. Taffs, R. (2009) Molecular level *in silico* analysis of mass and energy flows in microbial communities. *Geochim Cosmochim Acta* 73 (13), A193-A193.
  32. Arce, F.T., Carlson, R.P., Monds, R.J., Veeh, R., Hu, F.Z., Stewart, P.S., Lal, R., Ehrlich, G.D., Avci, R. (2009) Nanoscale structural and mechanical properties of nontypeable *Haemophilus influenzae* biofilms. *Journal of Bacteriology*. 191: 2512-2520.
  33. Carlson, R.P., Taffs, R., Davison, W.M., Stewart, P.S. (2008) Anti-biofilm properties of chitosan coated surfaces. *Journal of Biomaterials Science: Polymer Edition*. 19: 1035-1046.
  34. Gasper, G., Carlson, R.P., Akhmetov, A., Moore, J., Hanley, L. (2008) Laser Desorption 7.87 eV Postionization Mass Spectrometry of Antibiotics in *Staphylococcus epidermidis* Bacterial Biofilms. *Proteomics*. 8: 3816-3821.
  35. Carlson, R.P. (2007) Metabolic systems cost-benefit analysis for interpreting network structure and regulation. *Bioinformatics*. 23: 1258-1264.

36. Carlson, R., Sreenc, F. (2006) Gene dosage effects on polyhydroxyalkanoate production in *Saccharomyces cerevisiae*. *Journal of Biotechnology*. 124: 561-573.
37. Trinh, C.T., Carlson, R., Wlaschin, A.P., Khodursky, A., Sreenc, F. (2006) Design, construction, and performance of the most efficient *E. coli*. *Metabolic Engineering*. 8: 628-638.
38. Wlaschin, A.P., Trinh, C.T., Carlson, R., Sreenc, F. (2006) The fractional contributions of elementary modes to the metabolism of *Escherichia coli* and their estimation from reaction entropies. *Metabolic Engineering*. 8(4) 338-352.
39. Zhang, B., Carlson, R., Sreenc, F. (2006) Engineering the Monomer Composition of Polyhydroxyalkanoates Synthesized in *Saccharomyces cerevisiae*. *Applied and Environmental Microbiology*. 72(1): 536-543.
40. Kacmar, J., Carlson, R., Balogh, S. Sreenc, F. (2006) Automated staining and quantification of poly-3-hydroxybutyrate (PHB) in *Saccharomyces cerevisiae* and *Ralstonia eutropha* cell populations using flow cytometry. *Cytometry*. 69(1): 27-35.
41. Carlson, R., Wlaschin, A., Sreenc, F. (2005) Kinetic studies and biochemical pathway analysis of anaerobic poly(R)-3-hydroxybutyric acid synthesis in *Escherichia coli*. *Applied and Environmental Microbiology*. 71: 713-720.
42. Vijayasankaran, N., Carlson, R., Sreenc, F. (2005) Metabolic pathway structure for recombinant protein synthesis in *E. coli*. *Applied Microbiology and Biotechnology*. 68(6) 737-746.
43. Vijayasankaran, N., Carlson, R., Sreenc, F. (2005) Synthesis of Poly[(R)-3-hydroxybutyric acid] in the Cytoplasm of *Pichia pastoris* under Oxygen Limitation. *Biomacromolecules*. 6(2): 604-611.
44. Zhang, B., Carlson, R., Pederson, E., Witholt, B., Sreenc, F. (2005) Novel synthesis routes for polyhydroxyalkanoic acids with unique properties. *Polymer Biocatalysis and Biomaterials*. 900: 292-301.
45. Carlson, R., Sreenc, F. (2004) Fundamental *Escherichia coli* biochemical pathways for biomass and maintenance energy production: Identification of pathways. *Biotechnology and Bioengineering*. 85(1): 1-19.
46. Carlson, R., Sreenc, F. (2004) Fundamental *Escherichia coli* biochemical pathways for biomass and maintenance energy production: Creation of overall flux states. *Biotechnology and Bioengineering*. 86(2): 149-162.
47. Kacmar, J., Zamamiri, A., Carlson, R., Abu-Absi, N., Sreenc, F. (2004) Single-cell variability in growing *Saccharomyces cerevisiae* cell populations measured with automated flow cytometry. *Journal of Biotechnology*. 109(3): 239-254.
48. Carlson, R., Fell, D., Sreenc, F. (2002) Metabolic pathway analysis of a recombinant yeast for rational strain development. *Biotechnology and Bioengineering*. 79(2): 121-134.
49. Sreenc, F., Carlson, R. (2000) Metabolic engineering of polyhydroxyalkanoate synthesis in eukaryotic cells. *Proceedings of the Agricultural Biotechnology Symposium*. 2000: 90-103.

### Current External Research Funding:

- NIH (U01EB019416) Predictive Multiscale Modeling of Microbial Consortia Biofilms. (\$1.25 million) PI Carlson.
- DOE (DE-SC0012518) Center for Biological Electron Transfer and Catalyst ERC. (\$8 million) PI Peters, coPI Carlson.
- NSF (DMS-1361240) Emergent properties of synthetic microbial consortia. (\$745,616) PI Gedeon, coPI Carlson.
- NSF (MCB-1413321) A cellular systems analysis of microbe-arsenic interactions. (\$569,351) PI McDermott, coPI Carlson.
- Keck Foundation. Discovering Alkaliphilic Hyperthermophilic Archaea: Novel Organisms and Molecules. (\$2 million) PI Peyton, coPI Carlson.
- US Army Research Office (ARREOF) Development of Robust Microbial Communities through Engineered Biofilms (\$640,000) PI Carlson.

**Mentored personnel, graduate researchers:**

- Ashley Beck (PhD student Microbiology, Molecular Bioscience Fellow)
- Hans Bernstein (PhD Chem. Engin. 2013, NSF IGERT Fellow, PNNL Linus Pauling Fellow)
- Gerald Gasper (PhD Chemistry 2010, visiting student, University of Illinois, Chicago)
- Kristopher Hunt (PhD student Chem. Engin, NSF IGERT Fellow)
- Marketa Hulkova (PhD student, Fulbright Scholar, Czech Republic)
- Lourdes Jimenez-Taracido (PhD Microbiology, visiting student, University of Cadiz, Spain)
- Yeni Jung (PhD student Chemistry, visiting student, University of Illinois, Chicago)
- Natasha Mallette (PhD Chem. Engin 2013, co-advised, NSF IGERT Fellow)
- Lee McGill (PhD student Microbiology, Molecular Bioscience Fellow)
- Heidi Schoen (PhD student Chem. Engin, co-advised)
- Reed Taffs (MS Chem. Engin. 2013)

**Mentored personnel, undergraduate researchers:**

- Hans Bernstein (PhD Montana State 2013, Linus Pauling Fellow PNNL)
- Alissa Bleem (Goldwater Fellow, Howard H. Hughes Fellow, NSF Graduate Fellow, PhD student U of Washington)
- Roberto Fernandez Crespo (Spain)
- Steven Davis (McNair Fellow, Rhodes Scholar Finalist)
- Charles Fosseprez (AgroParisTech, France)
- James Gray
- Aaron Hedegaard (PhD University of Minnesota 2014)
- Katherine Lamm (Howard H. Hughes Fellow)
- Jenna Lloyd-Randolfi
- Edrey Cesar Mendes (Brazil)
- Kiera McNelis
- Steven Paulson
- Katheryn Pintar (Aasheim Torleif Fellow)
- Ashley Schrammeck
- Joao Sousa (Brazil)
- Reed Taffs (MS Montana State 2013)
- Patrick Tate (Rhodes Scholar Finalist, Marshall Scholar Nominee)
- Jean-Paul Toussaint (Medical School Student, University of Washington, Seattle)
- Pei Zhang
- Trevor Zuroff (NSF Graduate Fellow, McWhirter Graduate Fellow, PhD Penn State University 2014)

**Mentored personnel, post-doctoral researchers:**

- Dr. James Folsom (employed by Lonza Group)
- Dr. Zachary Jay, current
- Dr. Eunsung Kan (employed by University of Hawaii)
- Dr. Florence Mus (employed by Montana State University)
- Dr. Olu Oshota (employed by Cambridge University, UK)
- Dr. Matt Shipman (employed by US Navy)