

HALUK BEYENAL, Ph.D.

Paul Hohenschuh Distinguished Professor

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Professional experience

- 2015- Professor, The Gene and Linda Voiland School of Chemical Engineering and Bioengineering, Washington State University
- 2010-2015 Associate Professor, The Gene and Linda Voiland School of Chemical Engineering and Bioengineering, Washington State University
- 2006-2010 Assistant Professor, The Gene and Linda Voiland School of Chemical Engineering and Bioengineering, Washington State University
- 2002-2006 Research Assistant Professor, Center for Biofilm Engineering, Montana State University
- 1997-2001 Postdoctoral Researcher, Center for Biofilm Engineering, Montana State University
- 1996-1997 Research Fellow, Center for Biofilm Engineering, Montana State University
- 1991-1996 Research and Teaching Assistant, Chemical Engineering Department, Hacettepe University, Turkey

Education

- 1993-1997 Ph.D. in Chemical Engineering, Hacettepe University, Ankara, Turkey
- 1996-1997 Visiting Ph.D. Student, Center for Biofilm Engineering, Montana State University
- 1990-1993 M.S. in Chemical Engineering, Hacettepe University, Ankara, Turkey
- 1985-1990 B.S. in Chemical Engineering, Hacettepe University, Ankara, Turkey (with honors)

Research statement and significance

My research focuses on biofilm processes in energy applications, health and the environment. For energy applications we use the biofilms which exchange electrons with electrodes, called electrochemically active biofilms (ECABs). We use ECABs as a catalyst to convert chemical energy to electrical energy or to convert carbon dioxide to biofuels or commodity chemicals. Since ECAB processes are recently discovered, our fundamental understanding of electron transfer processes is limited. My group conducts research at the fundamental level to understand and control electron transfer processes in ECABs. This fundamental research has been supported by NSF-CAREER, ONR and DOE/PNNL. For medical applications, my research group focuses on developing novel technologies to control biofilms causing diseases, such as wound biofilms. The medical biofilms research has been supported by DoD, NIH and NSF-CARRER. Our research group uses biofilms for bioremediation. In addition, we use environmental biofilms for sediment microbial fuel cells (SMFCs) to power remote sensors. These research efforts have been supported by DOE, PNNL and NSF-CAREER. In addition to our research program, we use biofilms for educational purposes involving undergraduates and developed a new class (ChE 58/481 Biofilms), and these activities have been supported by NSF-CAREER and NIH.

Research areas

- Electrochemically active biofilms / electrochemistry
- Electron transfer processes in biofilms
- Biofilm structure quantification and image analysis
- Biofilm modeling
- Environmental monitoring
- Microsensors (optical and electrochemical) and applications
- Bioremediation using biofilms
- Biofuels and bioproducts using biofilms
- Environmental microbiology

Major accomplishments

Received NSF-CAREER award

3M non-tenured faculty award

Developed novel electrochemical techniques to study electrochemically active biofilms

Discovered applications of electrochemically active biofilms

Published a book on fundamentals of biofilm research (1st and 2nd editions)

Published an edited book on electrochemically active biofilms

Developed new electrochemical and optical microsensors

Discovered new treatment strategies for wound biofilms

Designed microbial fuel cells and developed technologies for using electricity from microbial fuel cells

Discovered that cyclic energy harvesting improved power from microbial fuel cells

Developed image analysis software for biofilm structure quantification

Organized workshops to teach biofilms

Teaching experience and classes taught

Co-Instructor; ChE 597 Protein Biotechnology (2016)

Instructor; ChE 510 Transport (2015,2016)

Instructor; ChE 598/498 Electrochemical Engineering (2015, 2017)

Instructor; ChE 596 Research Methods (2014)

Instructor; ChE 581 Biofilms (2009, 2011, 2013, 2014)

Instructor; ChE 481 Biofilms (2014)

Instructor; ChE 529 Chemical Engineering Kinetics (2011)

Instructor; ChE 465 Envirochemical Engineering (2009, 2010)

Instructor; ChE 398 and 498 Chemical Engineering Technical Seminars (2009, 2010)

Instructor; ChE 560 Advanced Biochemical Engineering (2/3 teaching load) (2009)

Instructor; ChE 433 Unit Operations Laboratory (2008)

Instructor; ChE 560 Advanced Biochemical Engineering (2007)

Instructor; ChE 475 Bioprocess Engineering (2006, 2007, 2010, 2011, 2012, 2013)

Instructor and Co-organizer; Biofilms Summer school (2006-2009, 2014, 2015)

Instructor and Co-organizer; Microsensors manufacture and applications workshop (2001-2009, 2014, 2015)

Instructor and Co-organizer; Biofilm structure quantification and image analysis workshop (2002-2009, 2014, 2015 and 2016 (at WSU))

Current graduate and undergraduate students and postdoctoral fellow

Phuc Ha, Post doctorate research associate

Sandra Milena Rincon Miranda, Ph.D. student (expected graduation date Fall 2018)

Adan Medina, Ph.D. student (expected graduation date Fall 2017)

Mia Mae, Ph.D. student (expected graduation date Spring 2017)

Mohammed Abdul, Ph.D. student (expected graduation date Spring 2018)

Secil Tutar, Ph.D. student (expected graduation date Spring 2018)

Banafsheh Molki, Ph.D. student (expected graduation date Spring 2019)

Mohamed Elharati, Ph.D. student (expected graduation date Spring 2020)

Previous graduate students and postdoctoral fellows

Jerome Babauta, Post doctorate research associate (October 2012-October 2015), currently a research associate in the Space and Naval Warfare Systems Command (SPAWAR), San Diego

Taimur Khan, Postdoctorate research associate (October 2012 – September 2013)

Bin Cao, Postdoctoral fellow (May 2009 – October 2011, currently an Assistant Professor in Nanyang Technological University, Singapore)

Emily Davenport, Ph.D. student (graduated Spring 2016, currently employed by Illumina)
Erhan Atci, Ph.D. student (graduated Spring 2016, currently employed by Intel)
Sujala Sultana, Ph.D. student (graduated Spring 2016, currently employed by Intel)
Timothy Harrington, Ph.D. student (graduated Spring 2015, currently employed by Illumina)
Timothy Ewing, Ph.D. student (graduated spring 2014, currently employed by Washington State University as an instructional laboratory manager)
Ryan Renslow, Ph.D. student (graduated Fall 2012, currently employed by Environmental Molecular Sciences Laboratory, Pacific Northwest National Laboratory, Richland, Washington 99352, U.S.A.)
Jerome Babauta, Ph.D. student (graduated Fall 2012)
Ozlem Istanbulu, Ph.D. student (graduated Fall 2012, currently employed as an assistant professor in the Hitit University)
Conrad Donovan, Ph.D. (graduated Fall 2012, started his own business)
Hung Duc Nguyen, Ph.D. (graduated Summer 2012, employed by Diana Jsc., A member of Unicharm Japan, Supply Chains & Activities Controller to Supply Chains Manager in Vietnam)
Bulbul Ahmed, Ph.D. student (graduated Fall 2012, currently employed In-Pipe technology, IL, U.S.A.)
Alim Dewan, Ph.D. student (graduated Spring 2010, currently he is a lecturer in Miami University)
Tanzil Abid Hossain, M.S. student (graduated Fall 2014)
Srilekha Nannapaneni, M.S. (Fall 2011)
Brian P., Esparza, M.S. (graduated Summer 2010)
Ryan Scott Renslow, M.S. (graduated Fall 2009)
Conrad Donovan, M.S. (graduated Fall 2009) (co-advised with Dr. Heo of Electrical Engineering)
Hung Duc Nguyen, M.S. (graduated Summer 2008)
Raja Angathevar Veluchamy, M.S. (Co-advisor, Montana State University, graduated Fall 2008)
Avinash Shantaram, M.S. (Co-advisor, Montana State University, graduated Fall 2008)
Enrico Marsili, Ph.D. (Co-advisor, Montana State University, graduated Fall 2006)
Allison Rhoads, M.S. (Co-advisor, Montana State University, graduated Fall 2004)
Suet Nee Chen, M.S. (Co-advisor, Montana State University, graduated Fall 2001)

Visiting scholars

Fei Guo, visiting PhD student, (April 2014 – March 2016)
Marselo Aybar, visiting PhD student (February 2014)
Beril Gul, visiting student (May 2013 – September 2013)
Antonio Rodríguez, Assistant Professor, Department of Enzymology and Chemical Engineering, Mexico. Joined my group for a month, 2013.
Qaiser F. Khan, visiting PhD student, (October 2012 – May 2014)
Alex Rosenthal, visiting PhD student (April 2012 and February 2014).
Vildan Caner, Associate Professor, Pammukkale University, Turkey. Joined my group for 2 months, 2012.
Tuba Ica, Assistant Professor of Microbiology, Dumlupınar University, Turkey. Joined my group for six months, 2010.
Jesús Rodríguez Martínez, Professor and Chair, Department of Enzymology and Chemical Engineering, Mexico. Joined my group for eight months during his sabbatical, 2009.
Raice Ahmed, Visiting Ph.D. student, Microbiology. Joined my group for seven months, 2009.

Undergraduate students involved research in my group (* paid, + indicates that this student joined PhD program either in WSU or other institutes)

Ines Maravilla*, Gretchen M. Tibbits*, Mia Kiamco*⁺ (published a research paper as a co-author), Vi Tran* (published a research paper as a co-author), Adan Medina*⁺, Mohammed Abdul*⁺ (published two research papers as a co-author), Zea Kiamco, Kayee Koey Wong⁺, Vi Tran*, Moataz Reda*⁺, Xiaoxue Hou*⁺, Jessica

Boyce*, Sarah Turner*, Sarah Sneesby*, David Tobin*, Matthew Shim* (published a research paper as a co-author), Kent Walker*, Michael Jonn*, Amanda Bates*, Ryan Renslow*+, Aaron Sinclair, Harvey Rojas Mora*, Wajma Arif*, Robert Tai, Sam Jochen, and Fabiola Quiroa.

Graduate committees served on

Zachary Joseph Speth, PhD committee, Chemical Engineering, Washington State University.
Azeza Falghoush, PhD committee, College of Veterinary Medicine, Washington State University.
Larissa Gribat, PhD committee, Chemistry, Washington State University.
Somayeh Ramezani, PhD committee, Chemical Engineering, Washington State University.
Baran Arslan, PhD committee, Chemical Engineering, Washington State University.
Buntu Godongwana, PhD committee, Chemical Engineering, Cape Peninsula, University of Technology, South Africa, External examiner. Graduated in 2016.
George Papacharalampos, PhD committee, Faculty of Environment and Technology, University of the West of England, Bristol, External examiner, Graduated in 2015.
Wang Bochuan Victor, PhD committee, Nanyang Technological University, School of Materials Science and Engineering, Singapore. External examiner. Graduated in 2016.
Pinar Gordasli, PhD committee, Chemical Engineering, Washington State University. Graduated in 2013.
Asma Eskan, Chemical Engineering, Washington State University. Graduated in 2013.
Marshall Sheerene Sheldon, PhD committee, Chemical Engineering, Cape Peninsula University of Technology, South Africa, External examiner. Graduated in 2009.
Bong-Je Park, PhD committee, Chemical Engineering, Ph.D., Washington State University. Graduated in 2010.
Reuven Miropolskiy, M.S, committee, Chemical Engineering, M.S., Chemical Engineering, M.S., Washington State University. Graduated in 2009.

Awards and honors

2014 Outstanding academic advisor, Washington State University, Graduate and Professional Student Association
2013 Office of Naval research, senior fellow for the summer faculty research program
2011 Outstanding researcher award, College of Architecture Washington State University
2010 Received NSF-CAREER award
2010 Outstanding researcher award, Chemical Engineering Department, Washington State University
2007 3M non-tenured faculty award
2005 Outstanding researcher award, College of Engineering, Montana State University
1996 Doctoral research fellowship for studying abroad, awarded by The Scientific and Technical Research Council of Turkey
1994-1996 Doctoral research fellowship, awarded by The Scientific and Technical Research Council of Turkey

Reviewer

Editorial board member (Handling manuscripts): *Nature Scientific Reports* (2016-)
Associate editor: *Frontiers - Microbiotechnology, Ecotoxicology and Bioremediation* (2016-)
Editorial board: *Biofouling* (2009-)
Ad Hoc: *Nature journals, Energy and Environmental Science, Biotechnology and Bioengineering, Environmental Science and Technology, Applied Environmental Microbiology, ChemElectroChem, Water Research, Sensors and Actuators B, Nature Scientific Reports, Chemical Engineering Science, Journal of*

Electroanalytical Chemistry, Bioelectrochemistry, Biochemical Engineering Journal, Journal of Membrane Science, Journal of Biotechnology, Biotechnology Progress, Biosystems, Journal of Hazardous Materials, Microbial Ecology, Environmental Toxicology and Chemistry, Reviews in Environmental Science and Bio/technology, Water, Air, & Soil Pollution, JoVE, Environmental Microbiology, Frontiers in Microbiology, Lab on a Chip, Czech Science Foundation, National Science Foundation, Department of Energy, Department of Defense, Coastal and Estuarine Environmental Technology (CICEET), JCATI, DARPA, and Air force.

PUBLICATIONS

BOOKS

1. Beyenal, H., Babauta, H. 2015. Electrochemically active biofilms in microbial fuel cells and bioelectrochemical systems: From laboratory practice to data interpretation. Wiley and Sons. Edited book. ISBN: 978-1-118-41349-4
2. Lewandowski, Z., Beyenal, H. 2013. Fundamentals of Biofilm Research. 2nd edition, CRC Press. ISBN 9781466559592
3. Lewandowski, Z., Beyenal, H. 2007. Fundamentals of Biofilm Research. CRC Press. ISBN 9780849335419

EDITED SPECIFIC ISSUE

4. Biofilm Structure and Activity. Water Science and Technology, 2005, Volume 52, Issue 7, Selected papers from Biofilms 2004: Biofilm Structure and Activity Conference, Editors: Lewandowski, Z., Beyenal, H.

PEER-REVIEWED JOURNAL ARTICLES

5. Ha, P.H., Lindemann, S.R., Shi, L., Dohnalkova, A.C., Fredrickson, J.K., Madigan, M. T., Beyenal, H. Syntrophic anaerobic photosynthesis via direct interspecies electron transfer. Nature Communications. <http://dx.doi.org/10.1038/ncomms13924> , In press.
6. Shi, L., Dong, H., Reguera, G., Beyenal, H., Lu, A., Liu, J., Yu, H., Fredrickson, J. K. 2016. Electrical interplay between microorganisms and minerals, Nature Microbiology reviews. 14, 651–662 (2016) <http://dx.doi.org/10.1038/nrmicro.2016.93>
7. Ewing, T., Ha, P. T., Beyenal, H. Evaluation of long-term performance of sediment microbial fuel cells and the role of natural resources, Applied Energy, In press. <http://dx.doi.org/10.1016/j.apenergy.2016.08.177>
8. Mohamed, A., Ewing, T., Lindemann, S. R., Fredrickson, J. K., Beyenal, H. 2016. Autonomous device for evaluating the field performance of microbial fuel cells in remote areas, Journal of Electrochemical Society, 164, H3030-3036. <http://dx.doi.org/10.1149/2.0041703jes>
9. Sultana, S, T., Call, D. R., Beyenal, H. Eradication of *Pseudomonas aeruginosa* biofilms and persister cells using an electrochemical scaffold and enhanced antibiotic susceptibility, NPJ Biofilms and Microbiomes. <http://dx.doi.org/10.1038/s41522-016-0003-0>
10. Sultana, S, T., Call, D. R., Beyenal, H. Maltodextrin enhances biofilm elimination by electrochemical scaffold, Nature, *Scientific reports*, 6, Article number: 36003 <http://dx.doi.org/doi:10.1038/srep36003>
11. Bernstein, H., Renslow, R., Dana, K., Morton, B., Lindemann, S., Song, H-S., Atci, E., Beyenal, H., Fredrickson, J., Jansson, J., Moran, J., Brislawn, C. Trade-offs between microbiome diversity and productivity in a stratified microbial mat, ISME J. In press. <http://dx.doi.org/10.1038/ismej.2016.133>

12. Tanzil, A. H., Sultana, S. T., Saunders, S. R., Dohnalkova, A., Shi, L., Devanport, E., Ha, P., Beyenal, H. 2016. Production of gold nanoparticles by electrode-respiring *Geobacter sulfurreducens* biofilms. *Enzyme and Microbial Technology*. 95, 69-75, <http://dx.doi.org/10.1016/j.enzmictec.2016.07.012>
13. Tanzil, A. H., Sultana, S. T., Saunders, Shi, L., Marsili, E., Beyenal, H. 2016. Biological synthesis of nanoparticles in biofilms. 95, 4, *Enzyme and Microbial Technology*. <http://dx.doi.org/10.1016/j.enzmictec.2016.07.015>
14. Babauta, J. T., Medina, A., Beyenal, H. EQCM and surface pH studies on lanthanum accumulation on electrodes in aqueous solution. *Journal of Electrochemical Society*. 163, H866-H870. <http://dx.doi.org/10.1149/2.1301609jes>
15. Atci, E., Babauta, J. T., Beyenal H. 2016. A hydrogen peroxide microelectrode to use in bioelectrochemical systems, *Sensors and Actuators B*. 226, 429-435. <http://dx.doi.org/10.1016/j.snb.2015.12.004>
16. James, G. A., Zhao, A. G., Usui, M., Underwood, R. A., Nguyen, H., Beyenal, H., Pulcini, E. D., Hunt, A., Bernstein, H. B., Fleckman, P., Olerud, J., Williamson, K. S., Franklin, M. J., Stewart, P. S., Microsensor and transcriptomic signatures of oxygen depletion in biofilms associated with chronic wounds, *Wound Repair and Regeneration*. 2016, 24, 373-383. <http://doi.wiley.com/10.1111/wrr.12401>
17. Atci, E., Babauta, J. T., Sultana, S. T., Beyenal, H. 2016. Microbiosensor for the detection of acetate in electrode-respiring biofilms. *Biosensors and Bioelectronics*. 81, 517-23, <http://dx.doi.org/10.1016/j.bios.2016.03.027>
18. Sultana, S. T., Atci, E., Babauta, J. T., Falghoush, A. M., Snekvik, K. R., Call, D. R., Beyenal, H. 2015. Electrochemical scaffold generates localized, low concentration of hydrogen peroxide that inhibits bacterial pathogens and biofilms. *Nature, Scientific reports*, 5, Article number: 14908. <http://dx.doi.org/10.1038/srep14908>.
19. Sultana, S. T., Babauta, J. T., Beyenal, H. 2015. Electrochemical biofilm control: A review. *Biofouling*, 31, 745-758. <http://dx.doi.org/10.1080/08927014.2015.1105222>
20. Ha, P. T., Renslow, R. S., Atci, E., Reardon, P. N., Lindemann, S. R., Fredrickson, J. K., Call D. R., and Beyenal, H. 2015. Regulation of electron transfer processes affects phototrophic mat structure and activity. *Front. Microbiol.*, 03 September 2015, <http://dx.doi.org/10.3389/fmicb.2015.00909>
21. Lone, A., Atci, E., Renslow, R., Beyenal, H., Noh, S., Fransson, B., Abu-Lail, N., Park, J., Gang, D., Call, D.R. 2015. Colonization of epidermal tissue by *Staphylococcus aureus* biofilm produces localized hypoxia and stimulates secretion of antioxidant and caspase-14 proteins. *Infection and Immunity*, 83(8):3026-34. <http://dx.doi.org/10.1128/IAI.00175-15>.
22. Harrington, T. D., Mohamed, A., Tran, V. N., Biria, S., Gargouri, M., Park, J-J., Gang, D. R., Beyenal, H. 2015. Neutral red-mediated microbial electrosynthesis by *Escherichia coli*, *Klebsiella pneumoniae*, and *Zymomonas mobilis*. *Bioresource Technology*, <http://dx.doi.org/10.1016/j.biortech.2015.06.005>
23. Kiamco, M. M., Atci, E., Khan, Q. F., Mohamed, A., Renslow, R. S., Abu-Lail, N., Fransson, B.A., Call, D. R., Beyenal, H. 2015. Vancomycin and maltodextrin affect structure and activity of *Staphylococcus aureus* biofilms. *Biotechnology and Bioengineering*, 112, 12, 2562-2570. <http://dx.doi.org/10.1002/bit.25681>
24. Harrington, T. D., Tran, V. N., Mohamed, A., Renslow, R., Biria, S., Orfe, S., Call, D. R., Beyenal, H. 2015. The mechanism of neutral red-mediated microbial electrosynthesis in *Escherichia coli*: menaquinone reduction. *Bioresource Technology*, 192, 689-695. <http://dx.doi.org/10.1016/j.biortech.2015.06.037>
25. Lone, A., Atci, E., Renslow, R., Beyenal, H., Noh, S., Fransson, B., Abu-Lail, N., Park, J., Gang, D., Call, D. 2015. *Staphylococcus aureus* induces hypoxia and cellular damage in porcine dermal explants. *Infection and Immunity*, 83, 2531-2541. <http://dx.doi.org/10.1128/IAI.03075-14>.
26. Tang, N., Hong, W., Ewing, B., Beyenal, H., Kim, J., Heo, D. 2015. A self-sustainable power management system for reliable power scaling up of sediment microbial fuel cells. *IEEE Transactions on Power Electronics*. September, 4626-4632. <http://dx.doi.org/10.1109/TPEL.2015.2397931>

27. Harrington, T. D., Babauta, T. J., Davenport, E. K., Renslow, R. S. 2015. Excess surface area in bioelectrochemical systems causes ion transport limitations. *Biotechnology and Bioengineering*, 5, 858-866. <http://dx.doi.org/10.1002/bit.25500>
28. Liu, Y., Zheming, W., Juan, L., Levar, C., Edwards, M., Babauta, J., Kennedy, D., Shi, Z., Beyenal, H., Bond, D., Clarke, T., Butt, J., Richardson, D., Rosso, K., Zachara, J., Fredrickson, J., Shi, L. 2014. A trans-outer membrane porin-cytochrome protein complex for extracellular electron transfer by *Geobacter sulfurreducens* PCA. *Environmental Microbiology Reports*, 6, 776-785. <http://dx.doi.org/10.1111/1758-2229.12204>
29. Babauta, J.T., Beyenal, H. 2014. Local current variation by depth in *Geobacter Sulfurreducens* biofilms. *Journal of Electrochemical Society*, 161, H3070-H3075. DOI: 10.1149/2.0131413jes
30. Ewing, T., Ha, T. P., Babauta, J. T., Tang, N., Heo, D., Beyenal, H. 2014. Scale-up of sediment microbial fuel cells. *Journal of Power Sources*, 272, 311-319. <http://dx.doi.org/10.1016/j.jpowsour.2014.08.070>
31. Resat, H., Renslow, S. R., Beyenal, H. 2014. Reconstruction of biofilm images: Combining local and global structural parameters. *Biofouling*, 30, 1141-1154. <http://dx.doi.org/10.1080/08927014.2014.969721>
32. Babauta, J. T., Hsu, L., Kagan, J., Chadwick, B., Beyenal, H., 2014. Multiple cathodic reaction mechanisms in seawater cathodic biofilms operating in sediment microbial fuel cells, *ChemSusChem*, 10, 2898-2906. <http://dx.doi.org/10.1002/cssc.201402377>
33. Babauta, J. T., Beasley, C., Beyenal, H., 2014. Investigation of electron transfer by *Geobacter sulfurreducens* biofilms using an electrochemical quartz crystal microbalance, *ChemElectroChem*, 1, 2007-2016. <http://dx.doi.org/10.1002/celec.201402127>
34. Ewing, T., Babauta, J. T., Atci, E., Tang, N., Orellana, J., Heo, D., Beyenal, H. 2014. Self-powered wastewater treatment for the enhanced operation of a facultative lagoon. *Journal of Power Sources*, 269, 284-292. <http://dx.doi.org/10.1016/j.jpowsour.2014.06.114>
35. Davenport, E. K., Call, D. R., Beyenal, H. 2014. Differential protection from tobramycin by extracellular polymeric substances from *Acinetobacter baumannii* and *Staphylococcus aureus* biofilms. *Antimicrobial Agents and Chemotherapy*, 58, 4755-4761. <http://dx.doi.org/10.1128/AAC.03071-14>.
36. Babauta, J.T., Atci, E., Ha, P., Lindemann, S., Ewing, T., Call, D.R., Fredrickson, J.K., Beyenal, H. 2014. Localized electron transfer rates and microelectrode-based enrichment of microbial communities within phototrophic microbial mat. Vol 5, Article 11, *Frontiers in Microbiology*, in special issue *Microbial Physiology and Metabolism*. <http://dx.doi.org/10.3389/fmicb.2014.00011>
37. Babauta, J., and Beyenal, H. 2014, Mass transfer studies of *Geobacter sulfurreducens* biofilms on rotating disk electrode. *Biotechnology and Bioengineering*, 111, 285-294. <http://dx.doi.org/10.1002/bit.25105>
38. Dewan, A., Ay, S., Karim, N., Beyenal, H. 2014. Alternative power sources for remote sensors: a review. *Journal of Power Sources*, 245, 129-143. <http://dx.doi.org/10.1016/j.jpowsour.2013.06.081>
39. Renslow, R. S., Babauta, J.T., Majors, P.D., Mehta, H.S., Ewing, R.J., Ewing, T.W. Mueller, K.T., Beyenal, H. 2014. A biofilm microreactor system for simultaneous electrochemical and nuclear magnetic resonance techniques. *Water Science and Technology*, 69, 966-973. <http://dx.doi.org/10.2166/wst.2013.802>
40. Renslow R. S., Babauta J. T., Kuprat, A., Schenk, J., Ivory, C. F., Fredrickson, J. K., Beyenal, H., 2013. Modeling biofilm with dual extracellular electron transfer mechanism. *Physical Chemistry Chemical Physics*, 15, 19362-19283. <http://dx.doi.org/10.1039/c3cp53759e>
41. Lindemann, S. R., Moran, J. J., Stegen, J. C., Mackley, R. D., Renslow, R. S., Hutchison, J. R., Cole, J. K., Dohnalkova, A. C., Tremblay, J., Singh, K., Malfatti, S. A., Chen, F., Tringe, S. G., Beyenal, H., Fredrickson, J. K. 2013. The epsomitic phototrophic microbial mat of Hot Lake, Washington: Community structural responses to seasonal cycling. *Frontiers in Microbiology*, in special issue *Microbial Physiology and Metabolism*, 4, 323. <http://dx.doi.org/10.3389/fmicb.2013.00323>

42. Babauta, J., Nguyen, H.D., Istanbulu, O., Beyenal, H. 2013. Microscale gradients of oxygen, hydrogen peroxide, and pH in fresh water cathodic biofilms. *ChemSusChem*, 6, 1252-1261. <http://dx.doi.org/10.1002/cssc.201300019>
43. Renslow R. S., Babauta J. T., Dohnalkova, A., Boyanov, M. I., Kemner, K. M., Majors, P. D., Fredrickson, J. K., Beyenal, H., 2013, Metabolic spatial variability in electrode respiring *Geobacter sulfurreducens* biofilms. *Energy and Environmental Science*, 6, 1827-1836. <http://dx.doi.org/10.1039%2FC3EE40203G>
44. Renslow, R. S., Babauta, J. T., Majors, P. D., Beyenal, H. 2013, Diffusion in biofilms respiring on electrodes. *Energy and Environmental Science*, 6, 595 - 607. <http://dx.doi.org/10.1039%2FC2EE23394K>
45. Donovan, C., Dewan, A., Heo, D., Beyenal, H. 2013. Sediment microbial fuel cell powering a submersible ultrasonic receiver: New approach to remote monitoring. *Journal of Power Sources*, 233, 79-85. <http://dx.doi.org/10.1016/j.jpowsour.2012.12.112>
46. Beyenal, H., Babauta, J. 2012. Microscale gradients and their role in electron transfer mechanisms in biofilms, *Biochemical Society Transactions*, 40, 1315-1318. <http://dx.doi.org/10.1042/BST20120105>
47. Ahmed, B., Cao, B., McLean, S. J., Ica, T., Dohnalkova, A., Fredrickson, J., Beyenal, H., 2012, Fe(III) Reduction and U(VI) immobilization by *Paenibacillus* sp. 300A isolated from Hanford 300A subsurface sediments. *Applied Environmental Microbiology*, 78, 8001-8009. <http://dx.doi.org/10.1128/AEM.01844-12>
48. Cao, B., Majors, P., Ahmed, B., Renslow, R., Dohnalkova, A., Sylvia, C.P., Shi, L., Fredrickson, J. K., Isern, N. G., Majors, P. D., Beyenal, H. 2012. Spatiotemporal metabolic responses of *Shewanella oneidensis* MR-1 biofilms to U(VI) and Cr(VI) exposure, *Environmental Microbiology*, 14, 2901-2910.
49. Babauta, T. J., Renslow, R., Lewandowski, Z., Beyenal, H. 2012, Electrochemically active biofilms: Facts and Fiction: review. *Biofouling*, 28, 789-812. <http://dx.doi.org/10.1080/08927014.2012.710324>
50. Istanbulu, O., Babauta, J., Nguyen, H. D., Beyenal, H. 2012, Electrochemical biofilm control: Mechanism of action. *Biofouling*, 28, 769-778. <http://dx.doi.org/10.1080/08927014.2012.707651>
51. Ahmed, B., Cao, B., Mishra, B., Boyanov, M. I., Kemner, K. M., Fredrickson, J. K., Beyenal, H. 2012, Immobilization of U(VI) from oxic groundwater by Hanford 300 Area sediments and effects of Columbia River water, *Water Research*, 46, 3989-3998. <http://dx.doi.org/10.1016/j.watres.2012.05.027>
52. Babauta, T. J., Nguyen, H. D., Harrington, T. D., Renslow, R., Beyenal, H. 2012, pH, redox potential and local biofilm potential microenvironments within *Geobacter sulfurreducens* biofilms and their roles in electron transfer, *Biotechnology and Bioengineering*, 109, 2651-2662. <http://dx.doi.org/10.1002/bit.24538>
53. DeVasConCello, P., Bose, S., Beyenal, H., Zirkle, L. G., Bandyopadhyay, A. 2012, Antimicrobial particulate silver coatings on stainless steel implants for fracture management, *Materials Science and Engineering C*, 32, 1112-1120. <http://dx.doi.org/10.1016/j.msec.2012.02.020>
54. Roy, M., Fielding, G., Beyenal, H., Bandyopadhyay, A., Bose, S. 2012, Mechanical, in vitro antimicrobial and biological properties of plasma sprayed silver-doped hydroxyapatite, *ACS Applied Materials & Interfaces*, 4, 1341-1349. <https://dx.doi.org/10.1021/am201610q>
55. Ica, T., Caner, V., Istanbulu, O., Nguyen, H. D., Ahmed, B., Call, D. R., Beyenal, H. 2012, Characterization of mono- and mixed-culture *Campylobacter jejuni* biofilms, *Applied Environmental Microbiology*, 78, 1033-1038. <http://dx.doi.org/10.1128/AEM.07364-11>
56. Nguyen, H. D., Renslow, R., Babauta, J., Ahmed, B., Beyenal, H. 2012, A voltammetric flavin microelectrode for use in biofilms. *Sensors and Actuators B: Chemical*, 161, 929-937. <http://dx.doi.org/10.1016/j.snb.2011.11.066>
57. Nguyen, H. D., Cao, B., Mishra, B., Boyanov, M. I., Kemner, K. M., Fredrickson, J. K., Beyenal, H. 2012, Microscale geochemical gradients in Hanford 300 Area sediment biofilms and influence of uranium, *Water Research*, 46, 227-234. <http://dx.doi.org/10.1016/j.watres.2011.10.054>

58. Renslow, R., Donovan, C., Shim, M., Babauta, J., Nannapaneni, S., Schenk, J., Beyenal, H. 2011, Oxygen reduction kinetics on graphite cathodes in sediment microbial fuel cells, *Physical Chemistry Chemical Physics*, 13, 21573-21584. <http://dx.doi.org/10.1039/c1cp23200b>
59. Babauta, T. J., Nguyen, H. D., Beyenal, H. 2011, Redox and pH microenvironments within *Shewanella oneidensis* MR-1 biofilms reveal electron transfer mechanisms, *Environmental Science and Technology*, 45, 6654-6660. <http://dx.doi.org/10.1021/es200865u>
60. Krol J.E., Nguyen, H. D., Rogers, L.M., Beyenal, H., Krone, S.M., Top, E.M. 2011, Increased transfer of a multi-drug resistance plasmid in *E. coli* biofilms at the air-liquid interface, *Applied Environmental Microbiology*, 77, 5079-5088. <http://dx.doi.org/10.1128%2FAEM.00090-11>
61. Cao, B., Ahmed, B., Kennedy, D. W., Shi, L., Marshall, M. J., Fredrickson, J. K., Isern, N. G., Majors, P. D., Beyenal, H. 2011, Contribution of Extracellular Polymeric Substances from *Shewanella* sp. HRCR-1 biofilms to U(VI) Immobilization, *Environmental Science and Technology*, 45, 5483-5490. <http://dx.doi.org/10.1021/es200095j>
62. Renslow, R., Lewandowski, Z., Beyenal, H. 2011, Biofilm image reconstruction for assessing structural parameters, *Biotechnology and Bioengineering*, 108, 1383-1394. <http://dx.doi.org/10.1002/bit.23060>
63. Cao, B., Shi, L., Brown, R., Xiong, Y., Fredrickson, J. K., Romine, M. F., Marshall, M. J., Lipton, M. S., Beyenal, H. 2011. Extracellular polymeric substances from *Shewanella* sp. HRCR-1 biofilms: characterization by infrared spectroscopy and proteomics. *Environmental Microbiology*, 13, 1018-1031. <http://dx.doi.org/10.1111/j.1462-2920.2010.02407.x>
64. Donovan, C., Dewan, A., Peng, H., Heo, D., Beyenal, H. 2011. Power management system for a 2.5 W remote sensor powered by a sediment microbial fuel cell. *Journal of Power Sources*, 196, 1171-1177. <http://dx.doi.org/10.1016/j.jpowsour.2010.08.099>
65. Renslow, R., Majors, P. M., McLean, S. J., Fredrickson, J. K., Bulbul, A., Beyenal, H. 2010. *In situ* effective diffusion coefficient profiles in live biofilms using pulsed-field gradient nuclear magnetic resonance. *Biotechnology and Bioengineering*, 106, 928-938. <http://dx.doi.org/10.1002/bit.22755>
66. McLean, S. J., Wanger, G., Gorby, Y. A., Wainstein, M., McQuaid, J., Ichi Ishii, S., Bretschger, O., Beyenal, H., Nealson, K. 2010. Quantification of electron transfer rates to a solid phase electron acceptor through the stages of biofilm formation from single cells to multicellular communities. *Environmental Science and Technology*, 44, 2721-2727. <http://dx.doi.org/10.1021/es903043p>
67. Dewan, A., Bernard Van Wie, Lewandowski, Z. Beyenal, H., 2010. Microbial fuel cells as an education tool, *Chemical Engineering Education*, 44, No.2, 157-165.
68. Ke, J., Sun, J.Z., Nguyen, H.D., Singh, D., Lee, K.C., Beyenal, H., Chen, S. 2010. In-situ oxygen profiling and lignin modification in guts of wood-feeding termites, *Insect Science*, 17, 277-290. <http://dx.doi.org/10.1111/j.1744-7917.2010.01336.x>
69. Dewan, A., Donovan, C., Heo, D., Beyenal, H. 2010. Evaluating the performance of microbial fuel cells powering electronic devices, *Journal of Power Sources*, 195, 90-96. <http://dx.doi.org/10.1016/j.jpowsour.2009.07.001>
70. Yeon, K., Cheong, W., Oh, H., Lee, W., Hwang, B., Lee, C., Beyenal, H., Lewandowski, Z. 2009. Quorum sensing: a new biofouling control paradigm in a membrane bioreactor for advanced wastewater treatment, *Environmental Science and Technology*, 43, 380-385. <http://dx.doi.org/10.1021/es8019275>
71. Dewan, A., Beyenal, H., Lewandowski, Z., 2009. Intermittent energy harvesting improves the performance of microbial fuel cells. *Environmental Science and Technology*, 43, 4600-4605. <http://dx.doi.org/10.1021/es8037092>
72. Donovan, C., Dewan, A., Heo, D., Beyenal, H. 2008. Batteryless, wireless sensor powered by a sediment microbial fuel cell, *Environmental Science and Technology*, 42, 8591-8596. <http://dx.doi.org/10.1021/es801763g>
73. Dewan, A., Beyenal, H., Lewandowski, Z. 2008. Scaling up microbial fuel cells. *Environmental Science and Technology*, 42, 7643-7648. <http://dx.doi.org/10.1021/es800775d>

74. Veluchamy, R.A., Beyenal, H., Lewandowski, Z. 2008. Characterizing temporal development of biofilm porosity using artificial neural networks. *Water Science and Technology*, 57, 1867-1872. <http://dx.doi.org/10.2166/wst.2008.608>
75. Marsili, E., Beyenal, H., Di Palma, L., Merli, C., Dohnalkova, A., Amonette, J.E., Lewandowski, Z. 2007. Uranium immobilization by sulfate reducing biofilms. *Environmental Science and Technology*, 41, 8349-8354. <http://dx.doi.org/10.1021/es0348703>
76. Lewandowski, Z., Beyenal, H., Myers, J., Stookey, D. 2007. The effect of detachment on biofilm structure and activity: the oscillating pattern of biofilm accumulation. *Water Science and Technology*, 55, 429-436. <http://dx.doi.org/10.2166/wst.2007.287>
77. Rani, S.A., Pitts, B., Beyenal, H., Veluchamy, R.A., Lewandowski, Z., Davison, W.M., Buckingham-Meyer, K., Stewart, P.S. 2007. Spatial patterns of DNA replication, protein synthesis and oxygen concentration within bacterial biofilms reveal diverse physiological states. *J Bacteriology*, 189 (11), 4223-4233. <http://dx.doi.org/10.1128/JB.00107-07>
78. Menicucci, J., Beyenal, H., Marsili, E., Veluchamy, R. A., Demir, G., Lewandowski, Z. 2006. A procedure for determining maximum sustainable power generated by microbial fuel cells. *Environmental Science and Technology*, 40, 1062-1068. <http://dx.doi.org/10.1021/es051180l>
79. Shantaram, A., Beyenal, H., Veluchamy, R. A., Lewandowski, Z. 2005. Wireless sensors powered by microbial fuel cells. *Environmental Science and Technology*, 39, 5037-5042. <http://dx.doi.org/10.1021/es0480668>
80. Rhoads, A., Beyenal, H., Lewandowski, Z. 2005. A microbial fuel cell using anaerobic respiration as an anodic reaction and biomineralized manganese as a cathodic reactant. *Environmental Science and Technology*, 39, 4666-4671. <http://dx.doi.org/10.1021/es048386r>
81. Beyenal, H., Lewandowski, Z. 2005. Modeling mass transport and microbial activity in stratified biofilms. *Chemical Engineering Science*, 60, 4337-4348. <http://dx.doi.org/10.1016/j.ces.2005.02.063>
82. Marsili, E., Beyenal, H., Di Palma, L., Merli, C., Dohnalkova, A., Amonette, J.E., Lewandowski, Z. 2005. Uranium removal by sulfate reducing biofilms in the presence of carbonates. *Water Science and Technology*, 52, 49-55.
83. Lewandowski, Z., Beyenal, H. 2005. Biofilms: Their structure, activity, and effect on membrane filtration. *Water Science and Technology*, 51, 181-192.
84. Beyenal, H., Donovan, C., Lewandowski, Z., Harkin, G. 2004. Three-dimensional biofilm image structure quantification. *Journal of Microbiological Methods*, 59, 395-413. <http://dx.doi.org/10.1016/j.mimet.2004.08.003>
85. Lewandowski, Z., Beyenal, H., Stookey, D. 2004. Reproducibility of biofilm processes and the meaning of steady state in biofilm reactors. *Water Science and Technology*, 49, 359-364.
86. Beyenal, H., Davis, C. C., Lewandowski, Z. 2004. An optical microsensor to measure fluorescent light intensity in biofilms. *Journal of Microbiological Methods*, 58, 367-374. <http://dx.doi.org/10.1016/j.mimet.2004.05.003>
87. Beyenal, H., Lewandowski, Z. 2004. Dynamics of lead immobilization in sulfate reducing biofilms. *Water Research*, 38, 2726-2736. <http://dx.doi.org/10.1016/j.watres.2004.03.023>
88. Beyenal, H., Sani, R. K., Peyton, B. M., Dohnalkova, A., Amonette, J. E., Lewandowski, Z. 2004. Uranium immobilization by sulfate reducing biofilms. *Environmental Science and Technology*, 38, 2067-2074. <http://dx.doi.org/10.1021/es0348703>
89. Beyenal, H., Lewandowski, Z., Harkin, G. 2004. Quantifying biofilm structure: facts and fiction. *Biofouling*, 20, 1-23. <http://dx.doi.org/10.1080/0892701042000191628>
90. Beyenal, H., Davis, C. C., Lewandowski, Z. 2004. An improved Severinghaus-type carbon dioxide microelectrode for use in biofilms. *Sensors and Actuators B, Chemical*, 97, 202-210. <http://dx.doi.org/10.1016/j.snb.2003.08.015>
91. Algirdas, J. J., Franklin, M. J., Berglund, D., Sasaki, M., Lord, C. M., Bleazard, J. B., Duffy, J. E., Beyenal, H., Lewandowski, Z. 2003. Compromised host defense on *Pseudomonas aeruginosa* biofilms:

- Characterization of neutrophil and biofilm interactions. *Journal of Immunology*, 171, 3911-3912. <http://dx.doi.org/10.4049/jimmunol.171.8.4329>
92. Yurt, N., Beyenal, H., Sears, J., Lewandowski, Z. 2003. Quantifying selected growth parameters of *Leptothrix discophora* SP-6 in biofilms from oxygen concentration profiles. *Chemical Engineering Science*, 58, 4557-4566. [http://dx.doi.org/10.1016/S0009-2509\(03\)00344-0](http://dx.doi.org/10.1016/S0009-2509(03)00344-0)
 93. Lewandowski, Z., Beyenal, H. 2003. Biofilm monitoring: A perfect solution in search of a problem. *Water Science and Technology*, 47, 1251-1556.
 94. Beyenal, H., Chen, S. N., Lewandowski, Z. 2003. The double substrate growth kinetics of *Pseudomonas aeruginosa*. *Enzyme and Microbial Technology*, 32, 92-98. [http://dx.doi.org/10.1016/S0141-0229\(02\)00246-6](http://dx.doi.org/10.1016/S0141-0229(02)00246-6)
 95. Beyenal, H., Lewandowski, Z. 2002. Internal and external mass transfer in biofilms grown at various flow velocities. *Biotechnology Progress*, 18, 55-61. <http://dx.doi.org/10.1021/bp010129s>
 96. Christensen, B. J., Ertesvag, H., Beyenal, H., Lewandowski, Z. 2001. Resistance of biofilms containing alginate-producing bacteria to disintegration by an alginate degrading enzyme (AlgL), *Biofouling*, 17, 203-210. <http://dx.doi.org/10.1080/08927010109378479>
 97. Beyenal, H., Lewandowski, Z. 2001. Mass transport dynamics, activity, and structure of sulfate reducing biofilms. *AIChE*, 47, 1689-1697. <http://dx.doi.org/10.1002/aic.690470721>
 98. Jackson, G., Beyenal, H., Rees, W. M., Lewandowski, Z. 2001. Growing reproducible biofilms with respect to structure and viable cell counts. *Journal of Microbiological Methods*, 47, 1-10. [http://dx.doi.org/10.1016/S0167-7012\(01\)00280-9](http://dx.doi.org/10.1016/S0167-7012(01)00280-9)
 99. Yang, X., Beyenal, H., Harkin, G., Lewandowski, Z. 2001. Evaluation of biofilm image thresholding methods. *Water Research*, 35, 1149-1158. [http://dx.doi.org/10.1016/S0043-1354\(00\)00361-4](http://dx.doi.org/10.1016/S0043-1354(00)00361-4)
 100. Beyenal, H., Lewandowski, Z., Yakymyshyn, C., Lemley, B., Wehri, J. 2000. Fiber optic microsensors to measure back scattered light intensity in biofilms. *Applied Optics*, 39, 3408-3412. <http://dx.doi.org/10.1364/AO.39.003408>
 101. Beyenal, H., Lewandowski, Z. 2000. Combined effects of substrate concentration and flow velocity at which biofilms were grown on effective diffusivity. *Water Research*, 34, 528-538.
 102. Yang, X., Beyenal, H., Harkin, G., Lewandowski, Z. 2000. Quantifying biofilm structure using image analysis. *Journal of Microbiological Methods*, 39, 109-119. [http://dx.doi.org/10.1016/S0167-7012\(99\)00097-4](http://dx.doi.org/10.1016/S0167-7012(99)00097-4)
 103. Seker, S., Beyenal, H., Tanyolaç, A. 1999. Modeling milk clotting activity in the continuous production of microbial rennet from *Mucor miehei*. *Journal of Food Science*, 64, 525-529. <http://dx.doi.org/10.1111/j.1365-2621.1999.tb15076.x>
 104. Beyenal, H., Seker, S., Salih, B., Tanyolaç, A. 1999. The effect of D-glucose on milk clotting activity of *Mucor miehei* in a chemostat with biomass retention. *Journal of Chemical Technology and Biotechnology*, 74, 527-532. [http://dx.doi.org/10.1002/\(SICI\)1097-4660\(199906\)74:6<527::AID-JCTB77>3.0.CO;2-J](http://dx.doi.org/10.1002/(SICI)1097-4660(199906)74:6<527::AID-JCTB77>3.0.CO;2-J)
 105. Tanyolaç, A., Beyenal, H. 1998. Prediction of substrate consumption rate, average biofilm density and active thickness for a thin spherical biofilm at pseudo-steady state. *The Biochemical Engineering Journal*, 2, 207-216. [http://dx.doi.org/10.1016/S1369-703X\(98\)00035-7](http://dx.doi.org/10.1016/S1369-703X(98)00035-7)
 106. Seker, S., Beyenal, H., Ayhan, F., Tanyolaç, A. 1998. Production of microbial rennin from *Mucor miehei* in a continuously fed fermenter. *Enzyme and Microbial Technology*, 23, 469-474. [http://dx.doi.org/10.1016/S0141-0229\(98\)00077-5](http://dx.doi.org/10.1016/S0141-0229(98)00077-5)
 107. Beyenal, H., Tanyolaç, A. 1998. The effects of biofilm characteristics on the external mass transfer coefficient in a fluidized bed biofilm reactor. *The Biochemical Engineering Journal*, 1, 53-61. [http://dx.doi.org/10.1016/S1369-703X\(97\)00010-7](http://dx.doi.org/10.1016/S1369-703X(97)00010-7)
 108. Beyenal, H., Tanyolaç, A., Lewandowski, Z. 1998. Measurement of local effective diffusivity in heterogeneous biofilms. *Water Science and Technology*, 38, 171-178. [http://dx.doi.org/10.1016/S0273-1223\(98\)00691-X](http://dx.doi.org/10.1016/S0273-1223(98)00691-X)

109. Xia, F., Beyenal, H., Lewandowski, Z. 1998. An electrochemical technique to measure local flow velocity in biofilms. *Water Research*, 32, 3637-3645. [http://dx.doi.org/10.1016/S0043-1354\(98\)00122-5](http://dx.doi.org/10.1016/S0043-1354(98)00122-5)
110. Beyenal, H., Seker, S., Salih, B., Tanyolaç, A. 1997. Diffusion coefficients of phenol and oxygen in a biofilm of *Pseudomonas putida*. *AIChE Journal*, 43, 243-250. <http://dx.doi.org/10.1002/aic.690430126>
111. Tanyolaç, A., Beyenal, H. 1997. Prediction of average biofilm density and performance of a spherical particle under substrate inhibition. *Biotechnology and Bioengineering*, 56, 319-329. [http://dx.doi.org/10.1002/\(SICI\)1097-0290\(19971105\)56:3%3C319::AID-BIT10%3E3.0.CO;2-B](http://dx.doi.org/10.1002/(SICI)1097-0290(19971105)56:3%3C319::AID-BIT10%3E3.0.CO;2-B)
112. Beyenal, H., Tanyolaç, A. 1997. A combined growth model of *Zoogloea ramigera* including multi-substrate, pH and mixing rate effects. *Enzyme and Microbial Technology*, 21, 74-78.
113. Seker, S., Beyenal, H., Salih, B., Tanyolaç, A. 1997. Multi-substrate growth kinetics of *Pseudomonas putida* for phenol removal. *Applied Microbiology and Biotechnology*, 47, 610-614. <http://dx.doi.org/10.1007/s002530050982>
114. Tanyolaç, A., Beyenal, H. 1996. Predicting average biofilm density of a fully active spherical bioparticle. *Journal of Biotechnology*, 52, 39-49. [http://dx.doi.org/10.1016/S0168-1656\(96\)01624-0](http://dx.doi.org/10.1016/S0168-1656(96)01624-0)
115. Beyenal, H., Tanyolaç, A. 1996. Simultaneous evaluation of effective diffusion coefficients of the substrates in a biofilm with a novel experimental method. *Canadian Journal of Chemical Engineering*, 74, 526-533. <http://dx.doi.org/10.1002/cjce.5450740413>
116. Tanyolaç, A., Beyenal, H. 1996. Effectiveness factor for a hollow fiber biofilm reactor at maximum substrate consumption. *The Chemical Engineering and Biochemical Engineering Journal*, 62, 149-154. [http://dx.doi.org/10.1016/0923-0467\(95\)03066-2](http://dx.doi.org/10.1016/0923-0467(95)03066-2)
117. Seker, S., Beyenal, H., Tanyolaç, A. 1995. The effects of biofilm thickness on biofilm density and substrate consumption rate in a differential fluidized bed biofilm reactor (DFBBR). *Journal of Biotechnology*, 41, 39-47. [http://dx.doi.org/10.1016/0168-1656\(95\)00050-Z](http://dx.doi.org/10.1016/0168-1656(95)00050-Z)
118. Demircioğlu, H., Beyenal, H., Tanyolaç, A., Hasirci, N. 1995. Entrapment of urease in glycol containing polymeric matrices and estimation of effective diffusion coefficient of urea. *Polymer*, 36, 4091-4096. [http://dx.doi.org/10.1016/0032-3861\(95\)90989-F](http://dx.doi.org/10.1016/0032-3861(95)90989-F)
119. Demircioğlu, H., Beyenal, H., Tanyolaç, A., Hasirci, N. 1994. Immobilization of urease and estimation of effective diffusion coefficients of urea in HEMA and VP copolymer matrices. *Polymer International*, 35, 321-327. <http://dx.doi.org/10.1002/pi.1994.210350404>
120. Beyenal, H., Tanyolaç, A. 1994. A mathematical model for hollow fiber biofilm reactors. *The Chemical Engineering and Biochemical Engineering Journal*, 56, B53-B59. [http://dx.doi.org/10.1016/0923-0467\(94\)87032-2](http://dx.doi.org/10.1016/0923-0467(94)87032-2)
121. Beyenal, H., Tanyolaç, A. 1994. The calculation of simultaneous effective diffusion coefficients of the substrates in a fluidized bed biofilm reactor. *Water Science and Technology*, 29, 463-470.

PEER-REVIEWED BOOK CHAPTERS

122. Babauta, J.T., and Beyenal, H. 2015. Introduction to electrochemically active biofilms. Beyenal, H., Babauta, H. In *Electrochemically active biofilms in microbial fuel cells and bioelectrochemical systems: From laboratory practice to data interpretation*. Edited book. Edited by Beyenal H., and Babauta, J.T. pp. 1-36. Wiley and Sons. <http://dx.doi.org/10.1002/9781119097426.ch1>
123. Babauta, J.T., and Beyenal, H. 2015. Biofilm electrochemistry. In *Electrochemically active biofilms in microbial fuel cells and bioelectrochemical systems: From laboratory practice to data interpretation*. Edited book. Edited by Beyenal H., and Babauta, J.T. pp.121-176. Wiley and Sons. <http://dx.doi.org/10.1002/9781119097426.ch5>
124. Renslow, R.S., Babauta, J. T., Kuprat, A., Schenk, J., Ivory, C. F., Fredrickson, J., Beyenal, H. 2015. Mathematical modeling of extracellular electron transfer in biofilms. In *Electrochemically active biofilms in microbial fuel cells and bioelectrochemical systems: From laboratory practice to data*

- interpretation. Edited book. Edited by Beyenal H., and Babauta, J.T. pp. 281-344. Wiley and Sons. <http://dx.doi.org/10.1002/9781119097426.ch9>
125. Beyenal, H., Babauta, J. 2013. Microsensors and microscale gradient in biofilms (In Biochemical engineering/biotechnology, edited by Muffler, K. and Ulber, R.), Springer. http://dx.doi.org/10.1007/10_2013_247.
 126. Abu-Lail, Nehal, Beyenal, H. 2013. Characterization of bacteria-biomaterial interactions from a single cell to microbial communities (in Characterization of Biomaterials, edited by 2), pp. 235-253, Elsevier. <http://dx.doi.org/10.1016/B978-0-12-415800-9.00006-1>
 127. Cao, B., Bulbul, A., and Beyenal, H. 2010. Immobilization of uranium in groundwater using biofilms. (in Emerging Environmental Technologies, Vol II, edited by V. Shah), pp. 1-38, Springer. http://dx.doi.org/10.1007/978-90-481-3352-9_1
 128. Lewandowski, Z., Beyenal., H. 2009. Methods for imaging and quantifying the structure of biofilms. (in Biofilms in the food and beverage industries, edited by P. Fratamico, B. Annous and J. Guenther. Woodhead Publishing. <http://dx.doi.org/10.1533/9781845697167.1.99>
 129. Lewandowski, Z., Beyenal., H. 2009. Mechanism of microbially influenced corrosion.(in Marine and Industrial Biofouling, edited by H.C. Flemming, R. Venkatesan, S.P. Murthy and K. Cooksey), Springer Series on Biofilms, pp. 35-64. http://dx.doi.org/10.1007/978-3-540-69796-1_3
 130. Lewandowski, Z., Beyenal, H. 2003. Mass transfer in heterogeneous biofilms (in Biofilms in Wastewater Treatment, edited by S. Wuertz, P.L. Bishop, and P.A. Wilderer), pp. 145-172, IWA Publishing, London.
 131. Lewandowski, Z., Beyenal, H. 2003. Use of microsensors to study biofilms (in Biofilms in Medicine, Industry and Environmental Biotechnology–Characteristics, Analysis and Control, edited by P. Lens, V. O'Flaherty, A. Moran, P. Stoodley, and T. Mahony), pp. 375-412, IWA Publishing, London.
 132. Lewandowski, Z., Beyenal, H. 2001. Limiting-current-type microelectrodes for quantifying mass transport dynamics in biofilms (in Methods in Enzymology, edited by R.J. Doyle), Vol: 331, pp. 337-359), Academic Press.

CONFERENCE AND SYMPOSIUM PRESENTATIONS (* invited presentation)

1. *Beyenal, H. Electrochemically active biofilms, the 229th Electrochemical Society meeting, San Diego, May 29-June 3
2. Medina, A., Babauta, J. T., Beyenal, H. An Electrogravimetric Approach: Electrochemical pre-concentration of lanthanum as La(OH)₃, the 229th Electrochemical Society meeting, San Diego, May 29-June 3.
3. Babauta, J. T., Medina, A., Beyenal, H. EQCM and surface pH studies on lanthanum accumulation on electrodes in aqueous solution, the 229th Electrochemical Society meeting, San Diego, May 29-June 3.
4. *Beyenal, H. Electron transfer mechanisms in biofilms. Workshop of US-China Collaborative Research on Microbe-Mineral Interaction: Microbial Extracellular Electron Transfer with Minerals as Electron Sources and Sinks, March 23-25, 2015, Zhongguanyuan Global Village PKU, Beijing, China.
5. Kiamco, M. M., Khan, Q., Atci, E., Mohamed, A., Fransson, B., Call, D., Abu-Lail, N. Beyenal, H. Combination of hyperosmotic agent and antibiotic enhances oxygen penetration into Staphylococcus aureus biofilms, SAWC Fall Meeting, September 26-28, 2015, Las Vegas NV.
6. Kagan, L., Hsu, A., Higier, Y.M. Arias-Thode, D.B. Chadwick, H. Beyenal, Design and performance considerations for benthic microbial fuel cells, 2014 Oceans - St. John's, OCEANS 2014.
7. Kiamco, M. M., Khan, Q., Atci, E., Mohamed, A., Lone, A., Fransson, B., Abu-Lail, N. Call, D., Beyenal, H. Oxygen Profiling and its Biokinetics in Wound Biofilms with and without Treatment, SAWC Fall Meeting, October 16-18, 2014, Las Vegas NV.

8. Lone, A., L. Orfe, Beyenal, H., Park, J-J., Gang, D. R., Fransson, B., Abu-Lail, N., Call, D. R. Porcine explant model yields multiple soluble compounds of physiological importance from MRSA biofilms. ASM 114th General meeting, May 17-20, 2014, Boston, MA.
9. Harrington, T. H., Beyenal, H. *Geobacter sulfurreducens* biofilm growth kinetics on high surface area, flow-through anodes under ion-transport limitations. 225th ECS Meeting, May 11-15, 2014, Orlando, FL.
10. Beyenal, H., Babauta, J. T., Renslow, R. S. Electrochemically active biofilms and their role in extracellular electron transfer processes. 225th ECS Meeting, May 11-15, 2014, Orlando, FL.
11. Renslow, R. S., P. D. Majors., Beyenal, H. Mass transfer and metabolic variability in electrochemically active biofilms. 225th ECS Meeting, May 11-15, 2014, Orlando, FL.
12. Babauta, J. T., Beyenal, H. Electrochemical impedance spectroscopy of *Geobacter sulfurreducens* biofilms on rotating disk electrodes. 225th ECS Meeting, May 11-15, 2014, Orlando, FL.
13. Beyenal, Kiamco, M. M., Khan, Q., Atci, E., Fransson, B., Call, D., Abu-Lail, N., Renslow, R. S. Hyperosmotic agents can enhance antibiotic efficacy against MRSA biofilms, SAWC Spring meeting, April 23-27, 2014, Orlando, FL.
14. Call, D., Lone, A., Beyenal, Fransson, B., Abu-Lail, N., Renslow, R. S. MRSA biofilms deplete oxygen within skin explants, SAWC Spring meeting, April 23-27, 2014, Orlando, FL.
15. Kiamco, M. M, Khan, M, T. K., Abu-Lail, N., Call, D, Beyenal, H. How biofilm inhibitors affect biofilm structure. 2013 BMES Annual meeting, September 25-28, Seattle, WA.
16. Beyenal, H., Sultana, S., Babauta, J. Mechanism of electrochemical biofilm control and its applications. 2013 BMES Annual meeting, September 25-28, Seattle, WA.
17. Tran, V., Harrington, T. D., Mohamed, A., Beyenal, H. Electron transfer mediator increases production of 1,3-propanediol, 2013 BMES Annual meeting, September 25-28, Seattle, WA.
18. *Beyenal, H. Sediment microbial fuel cells. 2nd Marine and renewable energy workshop, September 12-14, 2013, Jeju, Korea. Invited presentation.
19. Renslow, R., Babauta, J., Beyenal, H. Integration of electrochemical methods with magnetic resonance and electron microscopies for the study of *Geobacter sulfurreducens* biofilms. Microscopy and microscopy analysis 2012 meeting. July 29 - August 2, Phoenix, AZ.
20. Beyenal, H., Babauta, J. From electron mechanisms in biofilms to practical applications. 221st ECS meeting, May 6 – 10, Seattle, WA.
21. Renslow, R., Babauta, J., Schenk, J. O., Ivory, N., Beyenal, H. A dual extracellular electron transfer mechanism biofilm model. 221st ECS meeting, May 6 – 10, Seattle, WA.
22. Babauta, J., Nguyen, H., Beyenal, H. pH and redox potential variations in an anodic biofilm located in a three-electrode bioreactor and a microbial fuel cell. 221st ECS meeting, May 6 – 10, Seattle, WA.
23. Istanbulu, O., Babauta, J., Beyenal, H. A method to monitor biofilm formation from single cells to multicellular communities in food processing systems. Materials Research Society, 2012, Spring meeting and exhibit, San Francisco, CA.
24. Babauta, J., Nguyen, H. D., Harrington, T., Beyenal, H. pH and redox potential microenvironments in *Geobacter sulfurreducens* and *Shewanella oneidensis* MR-1 biofilms respiring on electrodes. American Chemical Society, 2012 Spring Meeting, March 25-29, San Diego, CA.
25. Beyenal, H., Bulbul, A., Renslow, R. Modeling of cellular metabolism and uranium immobilization in biofilms. American Chemical Society, 2012 Spring Meeting, March 25-29, San Diego, CA.
26. Renslow, R., Majors, P., Mehta, H., Babauta, J., Beyenal, H. Probing metabolic reactions in biofilms using nuclear magnetic resonance microscopy combined with electrochemical techniques. American Chemical Society, 2012 Spring Meeting, March 25-29, San Diego, CA.
27. Nguyen, H. D., Babauta, J., Bulbul, A., Beyenal, H., Development of voltammetric microsensor for flavin detection, 2011, 220th ECS Meeting & Electrochemical Energy Summit, October 9-14, Boston, MA .

28. James, G., Nguyen, H D., Beyenal, H., Zhao, H. A., Agostinho, A., deLancey P., Usui, M., Underwood, B., Fleckman, P., Olerud, J., Stewart, P. S. Bacterial biofilms are oxygen sinks in murine and in vitro Models of wound infection. Wound Healing Society, 2011 Annual Meeting, April, 14-17, Dallas, TX.
29. *Electrochemically active biofilms, Michigan State University, Department of Microbiology and Molecular Genetics, Lansing, MI, April, 10, 2010, Invited presentation.
30. Beyenal, H., Babauta, J., Renslow, R. Integrated experimental and modeling studies of extracellular electron transfer mechanisms in electrochemically active biofilms. American Chemical Society, 2011 Spring Meeting, March 27-31, Anaheim, CA.
31. Cao, B., Shi, L., Brown, R., Xiong, Y., Fredrickson, J. K., Romine, M. F., Marshall, M. J., Lipton, M. S., Beyenal, H. Extracellular polymeric substances of *Shewanella* biofilms contains redox active components with potential roles in extracellular electron transfer. American Chemical Society, 2011 Spring Meeting, March 27-31, Anaheim, CA.
32. McLean, J., Wanger, G., Beyenal, H., Cellular electron transfer rates quantified on a per cell basis for single cell on electrodes. American Chemical Society, 2011 Spring Meeting, March 27-31, Anaheim, CA.
33. *Use of microsensors to study biofilm processes, The City College of New York, Department of Civil Engineering, New York, NY, February 22, 2011, Invited presentation.
34. Nguyen, H. D., Cao, B., and Beyenal, H. Micro-Scale Chemistry Influences Uranium Immobilization in subsurface sediment biofilms from Hanford 300 Area. AIChE 2010 Annual Meeting, November 12, 2010, Salt Lake City, UT.
35. Dewan, A., Ewing, T., Nielsen, M.E., Reimers, C., Chadwick, B., Richter, K., Lewandowski, Z., Beyenal, H. Effect of location on the performance of benthic microbial fuel cells. Biofilm Reactor Technology Conference 2010, August 15-18, Portland, OR.
36. Beyenal, H., Microbial fuel cells, NORM/RMRM, 2010 Fuel cells technology symposium, June 21, 2010, Pullman, WA.
37. McLean, S. J., Wanger, G., Gorby, Y. A., Wainstein, M., McQuaid, J., Ichi Ishii, S., Bretschger, O., Beyenal, H., Nealson, K. Quantification of electron transfer rates to a solid phase electron acceptor through the stages of biofilm formation from single cells to multicellular communities. ASM 2010, General meeting, May 23-27, San Diego, CA.
38. Krol, J. E., Rogers, L. M., Nguyen, H., Beyenal, H., Krone, S. M., Top, E. M. Enhanced Plasmid Transfer in Bacterial Biofilms at the Air-Liquid Interface, ASM 2010, General meeting, May 23-27, San Diego, CA.
39. Beyenal, H., Dewan, A., Babauta, J., Nguyen, H., Renslow, R., Cao, B. Electrochemical and metabolic control of electron transfer in biofilms. 217th ECS meeting, April 25-30, 2010, Vancouver, Canada.
40. Renslow, R., Lewandowski, Z. Beyenal, H., Reconstructing biofilm structure from calculated parameters. IWA Biofilm Conference, September 15, 2009, Davis, CA.
41. Renslow, R., Majors, P. M., McLean, S. J., Ahmed, B., Beyenal, H. *In situ* effective diffusion coefficient profiles in live biofilms using PFG-NMR. The 10th International Conference on Magnetic Resonance Microscopy, August 30 - September 4, 2009, West Yellowstone, MT.
42. Beyenal, H., Dewan, A. Lewandowski, Z. Scaling up microbial fuel cells. Electrochemically Active Biofilms Meeting. November 19-21, 2008, Dourdan, France.
43. Beyenal, H., Nguyen, H. D., Stimulation of microbial metabolism in biofilms . AIChE 2008 Annual Meeting. November 16-21, Philadelphia, PA.
44. Beyenal, H., Donovan, C., Dewan, A. Lewandowski, Z. Optimizing power generation by microbial fuel cells. Ocean Sciences Meeting. March 2-7, 2008, Orlando, FL.
45. Lewandowski, Z., Beyenal, H. Microbial fuel cells – from laboratory studies to applications. Ocean Sciences Meeting. March 2-7, 2008, Orlando, FL.
46. Dewan, A, A, M., Van Wie, B. J., Lewandowski, Z., Beyenal, H. Microbial fuel cells as a multidisciplinary teaching tool. AIChE 2007 Annual Meeting. November 4-9, Salt Lake City, UT.

47. Beyenal, H., Theoretical modeling of phenolic wastewater treatment in a hollow fiber biofilm reactor. AIChE 2007 Annual Meeting. November 4-9, Salt Lake City, UT
48. *Beyenal, H., Image Structure Analyzer (ISA) to analyze biofilm images. 4th ASM Conference on Biofilms. March 25-29, 2007, Quebec City, Canada (invited presentation).
49. Beyenal, H., Donovan, C., Lewandowski, Z., Harkin, G. Image structure analyzer-2 (ISA-2) for quantifying biofilm structure. Biofilms 2004: Structure and Activity of Biofilms. October 24-26, 2004, Las Vegas, NV.
50. Marsili, E., Beyenal, H., Di Palma, L., Merli, C., Dohnalkova, A., Amonette, J. E., Lewandowski, Z. Immobilizing uranium in sulfate reducing biofilms. Biofilms 2004: Structure and Activity of Biofilms. October 24-26, 2004, Las Vegas, NV (presented by Marsili).
51. Beyenal, H., Sani, R. K., Peyton, B. M., Amonette, J. E., Lewandowski, Z. Uranium immobilization by sulfate reducing biofilms. AIChE 2003 Annual Meeting. November 16-21, San Francisco, CA.
52. Beyenal, H., Davis, C. C., Lewandowski, Z. An improved Severinghaus-type carbon dioxide microelectrode constructed using iridium oxide. AIChE 2003 Annual Meeting. November 16-21, San Francisco, CA.
53. Beyenal, H., Bartels, D., Yarwood, J., Yakymyshyn, C., Greenberg, E. P., Davis, C., Lewandowski, Z. Mapping toxic shock syndrome toxin-1 (TSST-1) expression in a biofilm of *Staphylococcus aureus* using TSST-1-*yfp*TM reporter strain and a *yfp*-sensitive fiber-optic sensor. 10th International Symposium on *Staphylococci* and *Staphylococcal* Infections. Tsukuba, Japan, October 16-19, 2002 (presented by Lewandowski).
54. Beyenal, H., Lewandowski, Z. Structure and activity of sulfate reducing biofilms and mineral-biofilm interactions during lead immobilization. AIChE 2001 Annual Meeting. November 4 - 9, Reno, NV.
55. Beyenal, H., Lewandowski, Z. Modeling activity of spherical bioparticles. The 2000 International Conference on Mathematics and Engineering Techniques in Medicine and Biological Sciences (METMBS'2000). June 26-29, 2000. Monte Carlo Resort, Las Vegas, Nevada.
56. Beyenal, H., Lewandowski, Z., Yakymyshyn, C., Lemley, B., Wehri, J. Fiber optic microsensors to measure back scattered light intensity in biofilm. Conference on Lasers and Electro-Optics (CLEO) 2000. Section: Novel technologies for biomedical optics, May 7-12, 2000, San Francisco, CA (presented by Yakymyshyn).
57. Beyenal, H., Lewandowski, Z. Internal and external mass transfer in biofilms grown at different flow velocity. AIChE 1999 Annual Meeting. October 31 - November 5, Dallas, TX.
58. *Beyenal, H. Application of fiber optic microsensors to biofilms. Optical Science and Laser Technology Conference. July 17-19, 1999. Montana State University, Bozeman (invited presentation).
59. Beyenal, H., Lewandowski, Z., Tanyolaç, A. Measurement of local effective diffusivity and cell density variations in heterogeneous biofilms. Vancouver Biennial Conference. June 21-26, 1998, Vancouver, Canada (presented by Lewandowski).