

ROBERT M. KELLY

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Websites: www.che.ncsu.edu/extremophiles/ (Research)
www.ncsu.edu/biotechnology (NCSU Biotechnology Program)

Education:

B.S. Chemical Engineering, University of Virginia, 1975
M.S. Chemical Engineering, University of Virginia, 1976
Ph.D. Chemical Engineering, North Carolina State University, 1981

Professional Experience:

1976-1978 Process Engr., Marshall Lab, E.I. DuPont Company, Philadelphia, PA
1978-1981 Project Engineer, EPA Coal Gasification/Gas Cleaning Test Facility,
North Carolina State University, Raleigh, NC
1981-1987 Assistant Professor of Chemical Engineering, Johns Hopkins University
1987-1991 Associate Professor of Chemical Engineering, Johns Hopkins University
1992-1998 Professor of Chemical Engineering, North Carolina State University
1998- Alcoa Professor of Chemical Engineering, North Carolina State University
2000- Director, NIH Molecular Biotechnology Training Program
2000- Director, NCSU Biotechnology Program (www.ncsu.edu/biotechnology)
2001-2002 Associate Vice-Chancellor for Research and Graduate Studies

Other Appointments:

1985-1989 Associate Research Scientist, Chesapeake Bay Institute, Shady Side, MD
1985-1990 Guest Scientist, NIST, Gaithersburg, MD
1985-1987 Research Bioengineer, National Institutes of Health, Bethesda, MD
1988-1992 Adjunct Res. Scientist, Center of Marine Biotechnology, Baltimore, MD
1999- Associate Member, Microbiology Program, NCSU
2000- Member, Genomics Faculty, NCSU
2016- Member, Center for Genetic Engineering and Society (GES), NCSU

Professional Societies:

American Institute of Chemical Engineers
Society of Sigma Xi
American Chemical Society
American Society for Microbiology
Middle Atlantic Biochemical Engineering Consortium
American Society for Molecular Marine Biology and Biotechnology
American Institute for Medical and Biological Engineering (AIMBE)
American Association for the Advancement of Science (AAAS)
Society for Industrial Microbiology (SIMB)
Society for Biological Engineering (AIChE)

Editorial Boards:

Molecular and Marine Biology and Biotechnology, 1991-1999
Journal of Molecular Catalysis B: Enzymatic, 1995-2003
Biotechnology Progress, 2000-
Biocatalysis and Biotransformations, 2000-2004
Applied Biochemistry and Biotechnology, 2003-
Archaea, 2004-
Applied and Environmental Microbiology, 2006-2014; Editor, 2012-2022
Journal of Bacteriology, 2006-2014
Extremophiles, 2012-
Microbial Biotechnology, 2016-

Scientific Advisory Boards:

Diversa Corporation, San Diego, CA, 1994-2004
Trevigen, Inc., Gaithersburg, MD, 1998-2002
DOE BCTR Program, 1993-1995
NSF Engr. Res. Center for Biofilm Engineering, Montana State University, 1993-1994
Thermophile Biology Institute, Montana State University, 2016-present

Selected Honors:

1996 Fellow, American Institute of Medical and Biological Engineering
2003 RJR Award for Excellence in Teaching, Research, and Extension, NC State University
College of Engineering
2004 American Chemical Society Marvin J. Johnson Award for Biochemical Technology
2007 Fellow, American Association for Advancement of Science (AAAS) (2007)
2007 American Institute of Chemical Engineers (AIChE) Food, Pharmaceutical and
Bioengineering (Division 15) Award
Distinguished Graduate Professor, NC State University
2012 Editor, *Applied and Environmental Microbiology*
2015 Global Vision Lecturer, SKIPER College, Institute of Process Engineering, Chinese
Academy of Sciences, Beijing, China
2018 American Soc. for Microbiology DuPont Biosciences Award in *Applied and
Environmental Microbiology* (shared with Michael W.W. Adams, University of Georgia)
2018 Lifetime Achievement Award, International Society for Extremophiles

Selected Professional Activities:

Founder, Middle Atlantic Biochemical Engineering Consortium (MABEC) (1985)
Conference Co-Chair (w/S. Karkare), Engineering Foundation Conference - *Biochemical
Engineering VIII*, Princeton, NJ (June, 1993)
Founding Scientific Advisory Board Member, Recombinant Biocatalysis/Diversa (1994)
Biotechnology for Business, Faculty Lecturer, Duke University (1994-2005), University of
California-Riverside (2005-2009)
Executive Comm., Food, Pharmaceutical & Bioeng. Div., AIChE, 1993-97 (Chair, 1996)
NIH Biotechnology Training Grant Study Section (1993-1997, 2006, 2009, 2014)
Co-Chair (w/ MWW Adams) NSF Workshop on *Extremozymes*, Wash., DC (May, 1994)
NAS Committee on Opportunities for Advancement of Marine Biotechnology, National Research
Council (1994-1998)

Symposium Co-Organizer (w/ MWW Adams), Banbury Conf. on *Biochemistry at 100°C – How are enzymes and their substrates stabilized?* Cold Spring Harbor, NY (1998)
Conference Co-Chair (w/ Frances Arnold and David Anton), Engineering Foundation Conference – *Enzyme Engineering* (1999)
Plenary Lecturer, Food, Pharmaceutical and Bioengineering Division, AIChE Annual Meeting, Los Angeles, CA (November, 2000)
Organizer (w/ MWW Adams, UGA) ACS Biotechnology Secretariat, San Diego (April, 2005)
NIHGMS Advisory Panel on Future of Pre-doctoral Training Programs (June, 2005)
Invited Lecturer, Gordon Conference on Archaea, Oxford, England (August, 2005)
Co-organized session at SF ACS Meeting in Honor of Fred Heineken's Retirement from NSF (May, 2010)
Activity Lead, Bioenergy Science Center (BESC), DOE Bioenergy Center (2010-2017)
Discussion Leader, National Academies Workshop on Research Frontiers in Bio-inspired Energy, Washington, DC (January, 2011)
Chair, Academic Advisory Board, Society of Biological Engineering, AIChE (2011-2017)
ASM-AAM Colloq. Steering Committee: Educating the Microbiologist of the Future (2012-13)
Advisory Committee, AIChE Meeting on Industrial Biotechnology for Production of Fuels and Chemicals (2014-2015)
Global Vision Lecturer, SKIPER College, Institute of Process Engineering, Chinese Academy of Sciences, Beijing, China (October, 2015)
Plenary Lecturer, Mini-Symposium on Biofuels and Biomaterials, Department of Biochemistry and Molecular Biology, University of Georgia (Athens, GA) (November, 2015)
Scientific Advisory Board, Thermophiles 2017, Kruger National Park, South Africa (Aug, 2017)
AAAS Electorate Nominating Committee – Engineering (2016-present), Chair (2017-18)
External International Advisory Board, Soehngen Institute of Anaerobic Microbiology (SIAM) – The Netherlands (2016-present)
Scientific Advisory Board, 12th International Congress of Extremophiles, September 16-20, 2018 (Ischia, Naples)
Scientific Advisory Board, Thermophiles 2019, September 2-6, 2019 (Fukuoka, Japan)
Invited Speaker, Gordon Conference on Bio-based Chemicals and Materials, July, 2019, Sunday River, ME
Scientific Advisory Board, Extremophiles 2020, September 13-17, 2020 (Loutraki, Greece)

Research Interests:

biomolecular engineering; biocatalysis; microorganisms from extreme environments; extreme thermophile biochemistry, physiology and ecology; metabolic engineering

Refereed Publications:

1. Gainer, J.V., J.L. Gainer, and R.M. Kelly. 1976. Steroids and oxygen solubility. *J. Steroids* **28**:307-310.
2. Kelly, R.M. and D.J. Kirwan. 1977. The electrochemical regeneration of NAD⁺ on carbon electrodes. *Biotechnol. Bioeng.* **19**:1275-1282.
3. Felder, R.M., R.M. Kelly, J.F. Ferrell, and R.W. Rousseau. 1980. How clean gas is made from coal. *Eng. Sci. Technol.* **19**:658-666.
4. Kelly, R.M., R.W. Rousseau, and J.K. Ferrell. 1982. Physical absorption of CO₂ and sulfur gases from coal: Simulation and experimental results. *Sep. Sci. Technol.* **16**:1389-1396.

5. Kelly, R.M., R.W. Rousseau, and J.K. Ferrell. 1984. Design of packed adiabatic absorbers: Physical absorption of acid gases in methanol. *Ind. Eng. Chem. Process Des. Dev.* **23**:102-109.
6. Rousseau, R.W., J.K. Ferrell, and R.M. Kelly. 1985. Cleaning of gases produced from coal using refrigerated methanol. *Chem. Eng. Commun.* **34**:27-34.
7. Olson, G.J., and R.M. Kelly. 1986. Microbiological metal transformations: Biotechnological applications and potential. *Biotechnol. Prog.* **2**:1-15.
8. Schubert, C.N., J.R. Lindner, and R.M. Kelly. 1986. Experimental methods for measuring static liquid holdup in packed columns. *AIChE J.* **32**:1920-1923.
9. Shiloach, J., J.B. Kaufman, and R.M. Kelly. 1986. Hollow fiber microfiltration methods for recovery of rat basophilic leukemia cells (RBL-2H3) from tissue culture media. *Biotechnol. Prog.* **2**:230-233.
10. Sturm, F.S., S.A. Hurwitz, J.W. Deming, and R.M. Kelly. 1987. Growth of the extreme thermophile, *Sulfolobus acidocaldarius*, in a hyperbaric helium bioreactor. *Biotechnol. Bioeng.* **29**:1066-1074.
11. Yeh, T.Y., J.R. Godshalk, G.J. Olson, and R.M. Kelly. 1987. Use of epifluorescence microscopy for characterizing the activity of *Thiobacillus ferrooxidans* on iron pyrite. *Biotechnol. Bioeng.* **30**:138-146.
12. Blumentals, I.I., A.K. Skaja, R.M. Kelly, and J. Shiloach. 1987. Effect of culturing conditions on the production of exotoxin A by *Pseudomonas aeruginosa*. *Ann. N.Y. Acad. Sci.*, **506**:663-670.
13. Sturm, F.J., A.K. Parameswaran, C.N. Provan, and R.M. Kelly. 1987. Growth of extremely thermophilic archaeobacteria under elevated hyperbaric conditions. *Ann. N.Y. Acad. Sci.* **506**:51-59.
14. Parameswaran, A.K., C.N. Provan, F.J. Sturm, and R.M. Kelly. 1987. Sulfur reduction by the extremely thermophilic Bacterium, *Pyrodictium occultum*. *Appl. Environ. Microbiol.* **53**:1690-1693.
15. Blumentals, I.I., R.M. Kelly, M. Gorziglia, J.B. Kaufman, and J. Shiloach. 1987. Development of a defined medium and two-step culturing method for improved exotoxin A yields from *Pseudomonas aeruginosa*. *Appl. Environ. Microbiol.* **53**:2013-2220.
16. Yeh, T.Y., R.M. Kelly, J. Cox, and G.J. Olson. 1988. Significance of cell fluorescence color of acridine orange-stained *Thiobacillus ferrooxidans* under epifluorescence microscopy. *Science and Technology Letters*.
17. Su, W.W., and R.M. Kelly. 1988. Effect of hyperbaric oxygen and carbon dioxide on the heterotrophic growth of the extreme thermophile, *Sulfolobus acidocaldarius*. *Biotechnol. Bioeng.* **31**:750-754.

18. Parameswaran, A.K., W-W. Su, R.N. Schicho, C.N. Provan, B. Malik, and R.M. Kelly. 1988. Engineering considerations for growth of bacteria at temperatures around 100°C. *Appl. Biochem. Biotechnol.* **18**:53-73.
19. Lindner, J.R., C.N. Schubert, and R.M. Kelly. 1988. Influence of hydrodynamics on mass transfer in packed columns. *Ind. Eng. Chem. Res.* **27**:636-642.
20. Parameswaran, A.K., R.N. Schicho, J.P. Soisson, and R.M. Kelly. 1988. Effect of hydrogen and carbon dioxide partial pressures on growth and sulfide production by the extremely thermophilic archaeobacterium, *Pyrodictium brockii*. *Biotechnol. Bioeng.* **32**:432-440.
21. Kelly, R.M., and J.W. Deming. 1988. Extremely thermophilic archaeobacteria: Biological and engineering considerations. *Biotechnol. Prog.* **4**:47-62.
22. Johnston, J.B., R.E. Hannah, V.L. Cunningham, B.P. Daggy, F.J. Sturm, and R.M. Kelly. 1988. Destruction of pharmaceutical and biopharmaceutical wastes by the MODAR supercritical water oxidation process. *Bio/technology* **6**:1423-1428.
23. Blumentals, I.I., R.M. Kelly, and J. Shiloach. 1989. Bioreactor operation for the production of exotoxin A by *Pseudomonas aeruginosa*. *Biotechnol. Bioeng.* **34**:1214-1220.
24. Pihl, T.D., R.N. Schicho, R.M. Kelly, and R.J. Maier. 1989. Characterization of hydrogen-uptake activity in the hyperthermophile *Pyrodictium brockii*. *Proc. Nat. Acad. Sci. USA* **86**:138-143.
25. Brown, S.H., and R.M. Kelly. 1989. Cultivation techniques for hyperthermophilic archaeobacteria: Continuous culture of *Pyrococcus furiosus* at temperatures near 100°C. *Appl. Environ. Microbiol.* **55**:2086-2088.
26. Schicho, R.N., S.H. Brown, G.J. Olson, and R.M. Kelly. 1989. Probing coals for non-pyritic sulfur using sulfur-metabolizing mesophilic and hyperthermophilic bacteria. *Fuel* **68**:1368-1375.
27. Malik, B., Su, W.-w., H.L. Wald, I.I. Blumentals, S. Brown, and R.M. Kelly. 1988. Growth and gas production by the hyperthermophilic archaeobacterium, *Pyrococcus furiosus*. *Biotechnol. Bioeng.* **36**:1050-1057.
28. Blumentals, I.I., S.H. Brown, R.N. Schicho, A.K. Skaja, H.R. Costantino, and R.M. Kelly. 1990. The hyperthermophilic archaeobacterium, *Pyrococcus furiosus*: development of culturing protocols, perspectives on scale-up, and potential applications. *Ann. N.Y. Acad. Sci.* **589**:301-314.
29. Reilly, J.T., C.N. Schubert, J.R. Lindner, M.D. Donohue, and R.M. Kelly. 1990. Effect of heterocyclic amine additives on the absorption rates of carbonyl sulfide and carbon dioxide in aqueous methyldiethanolamine solutions. *Chem. Eng. Commun.* **93**:181-187.
30. Clark, D.S., and R.M. Kelly. 1990. Microorganisms at extreme temperatures and pressures: Engineering insights. *CHEMTECH* **20**(11):641-648.

31. Blumentals, I.I., M. Itoh, G.J. Olson, and R.M. Kelly. 1990. The role of polysulfides in the reduction of elemental sulfur by the hyperthermophilic archaeobacterium, *Pyrococcus furiosus*. *Appl. Environ. Microbiol.* **56**:1255-1262.
32. Costantino, H.R., S.H. Brown, and R.M. Kelly. 1990. Purification and characterization of an α -glucosidase from the hyperthermophilic archaeobacterium, *Pyrococcus furiosus*, exhibiting a temperature optimum of 105-115°C. *J. Bacteriol.* **172**:3564-3660.
33. Blumentals, I.I., A.S. Robinson, and R.M. Kelly. 1990. Characterization of SDS-resistant proteolytic activity in the hyperthermophilic archaeobacterium, *Pyrococcus furiosus*. *Appl. Environ. Microbiol.* **56**:1992-1998.
34. Brown, S.H., H.R. Costantino, and R.M. Kelly. 1990. Characterization of amylolytic enzyme activities associated with the hyperthermophilic archaeobacterium, *Pyrococcus furiosus*. *Appl. Environ. Microbiol.* **56**:1985-1991.
35. Pihl, T.D., R.N. Schicho, L. Black, R.J. Maier, and R.M. Kelly. 1990. Hydrogen-sulfur autotrophy in the growth of the hyperthermophilic archaeobacterium, *Pyrodictium brockii*. *Biotechnol. Genetic Eng. Rev.* **8**:
36. Peeples, T.L., S. Hirose, V. Muralidharan, and R.M. Kelly. 1991. Coal sulfur transformations monitored by hyperthermophilic archaeobacteria. *Fuel* **70**:599-604.
37. Olson, G.J., and R.M. Kelly. 1991. Chemical and microbiological problems associated with research on the biodesulfurization of coal. *Resources, Conservation, and Recycling* **5**:183-189.
38. Snowden, L.J., I.I. Blumentals, and R.M. Kelly. 1992. Regulation of intracellular proteolysis in the hyperthermophilic archaeobacterium *Pyrococcus furiosus*. *Appl. Environ. Microbiol.* **58**:1134-41.
39. Schicho, R.N., Snowden, L.J., S. Mukund, J.B. Park, M.W.W. Adams, and R.M. Kelly. 1993. Influence of tungsten on metabolic patterns in the hyperthermophile *Pyrococcus furiosus*. *Arch. Microbiol.* **159**:380-385.
40. Kelly, R.M., I.I. Blumentals, L.J. Snowden, and M.W.W. Adams. 1992. Physiological and biochemical characteristics of *Pyrococcus furiosus*, a hyperthermophilic archaeobacterium. *Ann. N.Y. Acad. Sci.* **665**:309-320.
41. Brown, S.H., C. Sjöholm, and R.M. Kelly. 1993. Purification and characterization of a highly thermostable glucose isomerase produced by the extremely thermophilic eubacterium *Thermotoga maritima*. *Biotechnol. Bioeng.* **41**:878-886.
42. Brown, S.H., and R.M. Kelly. 1993. Characterization of amylolytic enzymes, having both α -1,4 and α -1,6 hydrolytic activity from the thermophilic archaea *Pyrococcus furiosus* and *Thermococcus litoralis*. *Appl. Environ. Microbiol.* **59**:2614-2621.
43. Kelly, R.M., and S.H. Brown. 1993. Enzymes from high temperature microorganisms. *Curr. Opin. Biotechnol.* **4**:188-192.

44. Schicho, R. N., Ma, K., Adams, M. W. W. and Kelly, R. M. 1993. Bioenergetics of sulfur reduction in the hyperthermophilic archaeon, *Pyrococcus furiosus* *J. Bacteriol.* **175**:1823-1830.
45. Schuliger, J.W., S.H. Brown, J.A. Baross, and R.M. Kelly. 1993. Purification of a novel amylolytic enzyme from ES4, a hyperthermophilic archaeum. *Mol. Marine Biol. Biotechnol.* **2**:76-87.
46. Ma, K., Schicho, R. N., Kelly, R. M., Adams, M. W. W. 1993. Hydrogenase of the hyperthermophile, *Pyrococcus furiosus*, is an elemental sulfur reductase or sulfhydrogenase: evidence for a sulfur-reducing hydrogenase ancestor. *Proc. Natl. Acad. Sci. USA* **90**:5341-5344.
47. Peeples, T.L., and R.M. Kelly. 1993. Bioenergetics of the metal/sulfur oxidizing extreme thermoacidophile, *Metallosphaera sedula*. *Fuel* **72**:1619-1624.
48. DiRuggiero, J., S.H. Brown, L.A. Achenbach, R.M. Kelly, and F.T. Robb. 1993. Regulation of ribosomal RNA transcription in the hyperthermophile, *Pyrococcus furiosus*: Evidence for a stringent response. *FEMS Lett.* **111**:159-164.
49. Adams, M.W.W., J.A. Baross and R.M. Kelly. 1994. Biotechnology and life in boiling water. *Chemistry in Britain* **30**:555-558.
50. Kelly, R.M., T.L. Peeples, S.B. Halio, K.D. Rinker and G.D. Duffaud. 1994. Metabolic strategies, genetic characteristics and biotechnological potential of extremely thermophilic microorganisms. *Ann. NY Acad. Sci.* **745**:409-425.
51. Adams, M.W.W., and R.M. Kelly. 1994. Thermostability and thermoactivity of enzymes from hyperthermophilic microorganisms. *Bioorg. Med. Chem.* **2**:659-667.
52. Kelly, R.M., and M.W.W. Adams. 1994. Metabolism in hyperthermophilic microorganisms. *Antonie van Leeuwenhoek* **66**:247-270.
53. Vieille, C., J.M. Hess, R.M. Kelly and J.G. Zeikus. 1995. *xylA* cloning and sequencing and biochemical characterization of xylose isomerase from *Thermotoga neapolitana*. *Appl. Environ. Microbiol.* **61**:1867-1875.
54. Peeples, T.L., and R.M. Kelly. 1995. Bioenergetic response of the thermoacidophilic archaeum *Metallosphaera sedula* to thermal and nutritional stress. *Appl. Environ. Microbiol.* **61**:2314-2321.
55. Adams, M.W.W., F.B. Perler and R.M. Kelly. 1995. Extremozymes: Expanding the limits of biocatalysis. *Bio/technology* **13**:662-668.
56. Adams, M.W.W., and R.M. Kelly. 1995. Enzymes from microorganisms from extreme environments. *Chem. Eng. News.* **73**:32-42.
57. Halio, S.B., I.I. Blumentals, S.A. Short, B.M. Merrill and R.M. Kelly. 1996. Sequence, expression in *Eschericia coli*, and analysis of the gene encoding a novel intracellular protease (PfpI) from the hyperthermophilic archaeon *Pyrococcus furiosus*. *J. Bacteriol.* **178**:2605- 2612.

58. McCutchen, C.M., G.D. Duffaud, P. Leduc, A.R.H. Petersen, A. Tayal, S.A. Khan and R.M. Kelly. 1996. Characterization of extremely thermostable enzymatic breakers (α -1,6-galactosidase and β -1,4-mannanase) from the hyperthermophilic bacterium *Thermotoga neapolitana* 5068 for hydrolysis of guar gum. *Biotechnol. Bioeng.* **52**:332-339.
59. Bauer, M.W., R. Swanson, E. Bylina, and R.M. Kelly. 1996. Comparison of a β -Glucosidase and a β -Mannosidase from the hyperthermophilic archaeon *Pyrococcus furiosus* Purification, characterization, gene cloning, and sequence analysis. *J. Biol. Chem.* **271**:23749-23755.
60. Kelly, R.M. 1996. Confessions of a graduate student recruiter. *Chem. Eng. Educ.* **30**:262-265.
61. Bauer, M.W., S.B. Halio, and R.M. Kelly. 1996. Protease and glycosyl hydrolases from hyperthermophilic microorganisms. *Adv. Prot. Chem.* **48**:271-310.
62. Rinker, K.D., and R.M. Kelly. 1996. Growth physiology of the hyperthermophilic archaeon *Thermococcus litoralis*: Development of a sulfur-free defined medium, characterization of an exopolysaccharide, and evidence of biofilm formation. *Appl. Environ. Microbiol.* **62**:4478-4485.
63. Duffaud, G.D., C.M. McCutchen, P. Leduc, K.N. Parker and R.M. Kelly. 1997. Purification and characterization of extremely thermostable β -mannanase, β -mannosidase and α -galactosidase from the hyperthermophilic eubacterium *Thermotoga neapolitana* 5068. *Appl. Environ. Microbiol.* **63**:169-177.
64. Halio, S.B., M.W. Bauer, S. Mukund, M.W.W. Adams, and R.M. Kelly. 1997. Purification and biochemical characterization of two functional forms of intracellular protease PfpI from the hyperthermophilic archaeon *Pyrococcus furiosus* *Appl. Environ. Microbiol.* **63**:289-295.
65. Bauer, M.W., S.B. Bauer and R.M. Kelly. 1997. Purification and characterization of a proteasome from the hyperthermophilic archaeon, *Pyrococcus furiosus*. *Appl. Environ. Microbiol.* **63**:1160-1164.
66. Han, C.J., C.H. Park, and R.M. Kelly. 1997. Acquired thermotolerance and 'stressed phase' growth of the extremely thermoacidophilic archaeon *Metallosphaera sedula* in continuous culture. *Appl. Environ. Microbiol.* **63**:2391-2396.
67. Muralidharan, V., K.D. Rinker, I.S. Hirsh, E.J. Bouwer, and R.M. Kelly. 1997. Hydrogen transfer between methanogens and fermentative heterotrophs in hyperthermophilic co-cultures. *Biotechnol. Bioeng.* **56**:268-278.
68. Tayal, A., R.M. Kelly, and S.A. Khan. 1997. Viscosity reduction of hydraulic fracturing fluids through enzymatic hydrolysis. *J. Soc. Petr. Eng. SPE* 38432.
69. Duffaud, G.D., O.B. d'Hennezel, A.S. Peek, A.-L. Reysenbach, and R.M. Kelly. 1998. Isolation and characterization of *Thermococcus barossii*, sp. nov., a hyperthermophilic archaeon isolated from a hydrothermal vent flange formation. *Syst. Appl. Microbiol.* **21**:40-49.

70. Han, C.J., and R.M. Kelly. 1998. Bioleaching capacity of the extremely thermoacidophilic archaeon *Metallosphaera sedula* under bioenergetic challenge. *Biotechnol. Bioeng.* **58**:617-624.
71. Adams, M.W.W., and R.M. Kelly. 1998. Finding and using hyperthermophilic enzymes. *TIBTECH* **16**:329-332.
72. Bauer, M.W., L.E. Driskill, and R.M. Kelly. 1998. Glycosyl hydrolases from hyperthermophilic microorganisms. *Curr. Opin. Biotechnol.* **9**:141-145.
73. Hess, J.M., V. Tchernajenko, C. Vieille, J.G. Zeikus, and R.M. Kelly. 1998. *Thermotoga neapolitana* homotetrameric xylose isomerase is expressed as a catalytically and thermostable dimer in *Eschericia coli*. *Appl. Environ. Microbiol.* **64**:2357-2360.
74. Kowalski, J.M., R.M. Kelly, J. Konisky, D.S. Clark, and D.K. Wittrup. 1998. Purification and functional characterization of a chaperone from *Methanococcus jannaschii*. *Syst. Appl. Microbiol.* **21**:173-178.
75. Hicks, P.M., K.D. Rinker, J.R. Baker, and R.M. Kelly. 1998. Multisubunit protease in the hyperthermophilic bacterium *Thermotoga maritima* has structural and amino acid sequence homology to a phage tail-like mesophilic bacteriocin. *FEBS Lett.* **440**:393-398.
76. Bauer, M.W., and R.M. Kelly. 1998. β -glucosidases from the mesophilic bacterium *Agrobacterium faecalis* and the hyperthermophilic archaeon *Pyrococcus furiosus* share common catalytic mechanisms. *Biochemistry* **37**:17170-17178.
77. Hess, J.M., and R.M. Kelly. 1999. Influence of polymolecular events on the inactivation behavior of the xylose isomerase from *Thermotoga neapolitana* 5068. *Biotechnol. Bioeng.* **62**:509-517.
78. Tayal, A., R.M. Kelly, and S.A. Khan. 1999. Rheological and molecular weight distribution patterns during enzymatic degradation of water-soluble polymers. *Macromolecules* **32**:294-300.
79. Bauer, M.W., L.E. Driskill, W. Callen, E.J. Mathur, and R. M. Kelly. 1999. An endoglucanase from the hyperthermophilic archaeon *Pyrococcus furiosus* hydrolyzes β -1,4 bonds in mixed linkage (1 \rightarrow 3),(1 \rightarrow 4)- β -D-glucans and cellulose. *J. Bacteriol.* **181**:284-290.
80. Driskill, L.E., K. Kusy, M.W. Bauer, and R.M. Kelly. 1999. Relationship between glycosyl hydrolase inventory and growth physiology of the hyperthermophile *Pyrococcus furiosus* on carbohydrate-based media. *Appl. Environ. Microbiol.* **65**:893-897.
81. Kelly, R.M., and H. Waldmann. 1999. Biocatalysis and biotransformation. Editorial overview. *Current Opin. Biol.* **3**:9-10.
82. Rinker, K.D., C.J. Han and R.M. Kelly. 1999. Continuous culture as a tool for investigating the growth physiology of heterotrophic hyperthermophiles and extreme thermoacidophiles. *J. Appl. Bacteriol.* **85**:118S-127S.

83. Driskill, L.E., M.W. Bauer and R.M. Kelly. 1999. Synergistic interactions among the β -laminarinase, β -1,4-glucanase and β -glucosidase from the hyperthermophilic archaeon *Pyrococcus furiosus* during the hydrolysis of β -1,4-, β -1,3-, and mixed-linked polysaccharides. *Biotechnol. Bioeng.* **66**:51-60.
84. Rinker, K.D., and R.M. Kelly. 2000. Effect of carbon and nitrogen sources on growth dynamics and exopolysaccharide production for the hyperthermophilic archaeon *Thermococcus litoralis* and bacterium *Thermotoga maritima*. *Biotechnol. Bioeng.* **69**:537-547.
85. Pysz, M.A., K.D. Rinker, K.R. Shockley, and R.M. Kelly. 2001. Continuous cultivation methods for hyperthermophilic biomass and enzyme production. *Meth. Enzymol.* **330**:31-40.
86. Vielle, C., D. Sriprapundh, R.M. Kelly, and J.G. Zeikus. 2001. Xylose isomerases from *Thermotoga* spp. *Meth. Enzymol.* **330**:215-224.
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23. Tachdjian, S., and R.M. Kelly. 2007. Functional Genomics of Stress Response. In **Archaea: New Models for Prokaryotic Biology**, P. Blum, Editor.
24. Gray, S.R., M.W.W. Adams, and R.M. Kelly. 2010. Extremely thermophilic microorganisms. **Encyclopedia of Industrial Biotechnology: Bioprocess, Bioseparation, and Cell Technology**, 2nd edition, M.C. Flickinger, Editor, John Wiley and Sons, NY, 5:3481-3499.
25. Harris, J.M., M.W.W. Adams, and R.M. Kelly. 2010. Extremely thermophilic enzymes. **Encyclopedia of Industrial Biotechnology: Bioprocess, Bioseparation, and Cell Technology**, 2nd edition, M.C. Flickinger, Editor, John Wiley and Sons, NY, 4:2247-2264.
26. Ozdemir, I., and R.M. Kelly. 2010. Extremophiles. **Encyclopedia of Catalysis**, I.T. Horváth, Ed., John Wiley and Sons, NY. DOI: 10.1002/0471227617.eoc089.pub2
27. Zurawski, J.V., S.E. Blumer-Schuetz, J.M. Conway, and R.M. Kelly. 2014. The Extremely Thermophilic Genus *Caldicellulosiruptor*. Physiological and Genomic Characteristics for Complex Carbohydrate Conversion to Molecular Hydrogen. *Microbial BioEnergy: Hydrogen Production*, pp. 177-195 (D. Zannoni and R. DePhilippis, Eds.), Springer Netherlands.
28. Schut, G.J., G.L. Lipscomb, Y. Han, J.S. Notey, R.M. Kelly, and M.W.W. Adams. 2014. The Order Thermococcales and the Family Thermococcaceae. **The Prokaryotes**, 4th Ed., pp. 363-383 (Rosenberg, Lory, DeLong, Thompson, Stackebrandt, Eds.), Springer Berlin Heidelberg.
29. Conway, J.M., J.V. Zurawski, L.L. Lee, S.E. Blumer-Schuetz and R.M. Kelly. 2015. Lignocellulosic Biomass Deconstruction by the Extremely Thermophilic Genus *Caldicellulosiruptor*. Chapter 4, pp. 91-119, In **Thermophilic Microorganisms** (F. Li, Editor), Horizon Scientific Press.
30. Loder, A.J., B.M. Zeldes, J.M. Conway, J.A. Counts, C.T. Straub, P.A. Khatibi, L.L. Lee, N.P. Vitko, M.W. Keller, A.M. Rhaesa, G.M. Rubenstein, I.M. Scott, G.L. Lipscomb, M.W.W.

Adams, and R.M. Kelly. 2017. Chapter 14. Extreme Thermophiles as Metabolic Engineering Platforms: Strategies and Current Perspective. In **Industrial Biotechnology** (C. Wittmann and J. Liao, Editors), Wiley-VCH Biotechnology Series (S.-Y. Lee, J. Nielsen, and G. Stephanopoulos, Editors) Vol 3b, pp. 507-580.

Patents/Patent Applications:

1. Kelly, R.M., A.S. Robinson, I.I. Blumentals, S.H. Brown, and C.B. Anfinsen. Proteolytic Enzymes from Hyperthermophilic Bacteria and Processes for their Production. U.S. Patent Number 5,242,817, Sept. 7, 1993.
2. Starnes, R.L., R.M. Kelly, and S.H. Brown. Novel Isomerization Enzymes. U.S. Patent Number 5,219,751, June 15, 1993.
3. Starnes, R.L., R.M. Kelly, and S.H. Brown. Method for glucose isomerization using xylose isomerase purified from *Thermotoga maritima* and *Thermotoga neapolitana*. U.S. Patent Number 5,268,280, December, 1993.
4. Kelly, R.M., A.S. Robinson, I.I. Blumentals, S.H. Brown, and C.B. Anfinsen. Proteolytic enzymes from hyperthermophilic bacteria and processes for their production. U.S. Patent Number 5,391,489, February, 1995.
5. Kelly, R.M., S.A. Khan, P. Leduc, A. Tayal and R. Prud'homme. Methods and compositions for fracturing subterranean formations. U.S. Patent Number 5,421,412, June, 1995.
6. Luhm, R.A., O.B. d'Hennezel, G.D. Duffaud, J.F. Jolly, R.M. Kelly, and E. Y.-F. Ting. Purified *Thermococcus barossii* DNA polymerase. U.S. Patent Number 5,602,011, February, 1997.
7. Kelly, R.M., S.A. Khan, P. Leduc, A. Tayal and R. Prud'homme. Methods and compositions for fracturing subterranean formations. U.S. Patent Number 5,869,435, February, 1999.
8. Kelly, R.M., S.A. Khan, P. Leduc, A. Tayal and R. Prud'homme. Methods and compositions for fracturing subterranean formations. U.S. Patent Number 6,197,730, March, 2001.
9. Kelly, R.M., S.H. Brown, H.R. Costantino, and C.B. Anfinsen. Saccharification enzymes from hyperthermophilic bacteria and processes for their production. U.S. Patent Number 6,355,467, March, 2002.
10. Kelly, R.M., S.A. Khan, P. Leduc, A. Tayal and R. Prud'homme. Methods and compositions for fracturing subterranean formations. U.S. Patent Number 6,428,995, August, 2002.
11. Kelly, R.M., S.A. Khan, P. Leduc, A. Tayal and R. Prud'homme. Methods and compositions for fracturing subterranean formations. U.S. Patent Number 6,936,454, August, 2005.
12. Adams, M.W.W., R.M. Kelly, A.S. Hawkins, A.L. Menon, G.P. Lipscomb, and G.J. Schut. Sequestration of CO₂ with H₂ into useful products. US Patent Number 9,587,256, March, 2017; (International Application (PCT/US2013/058593 filed 09/2013)
13. Kelly, R.M., M.W.W. Adams, G. Schut, and M. Basen. Genetically engineered microbes and methods for converting organic acid to alcohols. US Patent Application (14/670,601; filed 03/2015)

Published Proceedings and Reports:

1. Muralidharan, V., I.S. Hirsh, I. Suy, E.J. Bouwer, and R.M. Kelly. Mixed Cultures of High Temperature Bacteria: Prospects for Bioprocessing of Fossil Fuels. *Proceedings of the 2nd International Conference on the Biological Processing of Fossil Fuels*, Department of Energy/EPRI, May, 1991.
2. Olson, G.J., T.L. Peebles, I.I. Blumentals, R.N. Schicho, S.H. Brown, and R.M. Kelly. Bioprocessing of Fossil Fuels Using Hyperthermophilic Archaeobacteria. *Proceedings of the 14th Annual EPRI Conference on Fuel Science and Conversion*, Palo Alto, CA, May, 1989.
3. Pihl, T.D., R.N. Schicho, R.M. Kelly, and R.J. Maier. Characterization of the H₂-Uptake Hydrogenase Activity from the Extreme Thermophile *Pyrodictium brockii*. *Proc. 1st International IGT Symposium on Gas, Oil, and Coal Biotechnology*.
4. Kelly, R.M., R.N. Schicho, S.H. Brown, J.P. Soisson, I.I. Blumentals, G.J. Olson, and E.J. Parks. Biological Sulfur Oxidation and Reduction for Coal Sulfur Speciation and Desulfurization. *Proceedings of the 13th Annual EPRI Conference on Fuel Science and Conversion*, Santa Clara, CA, May, 1988.
5. Kelly, R.M., and G.J. Olson. Specific Biocatalysis for Coal Sulfur Speciation and Removal. EPRI ER/GS-6624, Electric Power Research Institute Interim Report, May, 1990.
6. Kelly, R.M., R.W. Rousseau, and J.K. Ferrell. Coal Gasification/Gas Cleanup Test Facility: Vol. IV. A Mathematical Model of the Packed Column Acid Gas Absorber. EPA 600/7-83-053 (1983).
7. Ferrell, J.K., R.M. Felder, R.W. Rousseau, S. Ganesan, R.M. Kelly, J.C. McCue, and M.J. Purdy. Coal Gasification/Gas Cleanup Test Facility: Vol III: Environmental Assessment of Operation with New Mexico Subbituminous Coal and Chilled Methanol. EPA-600/7-82-054, (1982).
8. Ferrell, J.K., R.M. Felder, R.W. Rousseau, S. Ganesan, R.M. Kelly, J.C. McCue and M.J. Purdy. Coal Gasification/Gas Cleanup Test Facility: Vol. II: Environmental Assessment of Operation with Devolatilized Bituminous Coal and Chilled Methanol. EPA-600/7-82-023 (1982).
9. Ferrell, J.K., R.M. Felder, R.W. Rousseau, J.C. McCue, R.M. Kelly, and W.E. Willis. Coal Gasification/Gas Cleanup Test Facility: Vol. I: Description and Operations. EPA-600/7-80-046a (1980).
10. Montero, C.I., C.I. Montero, S.B. Connors, M.R. Johnson, M.A. Pysz, K.R. Shockley, and R.M. Kelly. Microbial ecology of hydrothermal biotopes. Proc. of the Annual Meeting of the SPIE, August, 2003.

Past and Present Research Supported By: American Cyanamid Company, W.R. Grace Company, National Science Foundation, Electric Power Research Institute, Office of Naval Research, Department of Energy, Energy Biosciences, Schering-Plough Corp., Novo-Nordisk, Pharmacia, North Carolina Biotechnology Center, Kraft-General Foods, Sphinx Pharmaceuticals,

Dowell-Schlumberger, DuPont, FMC, USDA, Trevigen, National Renewable Energy Laboratory, Syngenta (formerly Novartis Agricultural Biotechnology Institute), Bayer Corp., National Institutes of Health, Department of Education, Diversa Corporation, NASA, BD Technologies, Inc., Integrated Laboratory Sciences (RTP, NC), Genencor, CAPPs, DOE GTL, DTRA, NIH, ORNL-Battelle, DOE ARPA-E, AFOSR

Courses Taught: Mass Transfer Operations, Process Dynamics and Control, Process Modeling and Simulation, Biochemical Engineering/Biotechnology, Separation Processes, Advanced Biochemical Engineering, Transport Processes, Biomacromolecules, Graduate Research Ethics, Graduate Capstone Biotechnology, Fermentation of Recombinant Microorganisms, Protein Purification, Graduate Professional Development, Biomolecular Engineering.

Selected Departmental/University Service:

JHU:

Graduate Student Recruiting Coordinator (1981-1985)
Engineering School Faculty Steering Committee (1984-86; Vice Chair of Faculty, 1986)
Ethics Board (1986-88; Chair, 1988)
Advisory Board for University Investments (1986-1988)
Undergraduate Admissions Committee (1983-1986)

NCSU:

Graduate Student Recruiting Coordinator (1993-1996)
Chair, Faculty Search Committee (1997-1999; 2001-2002)
Member, Faculty Search Committee (2008-2009)
University Research Committee (1996-2000; Chair 1999-2000)
University Radiation Safety Committee (1995-1997)
Chair, College of Engineering Research Committee (1998-1999)
Director, NCSU Biotechnology Program (2000-present)
Graduate Student Support Plan Task Force (2000)
Co-PI, GAANN Biotechnology Fellowship Program, Dept. of Education (2001-present)
Director, NCSU NIH Biotechnology Training Program (2000- present)
Ad Hoc Committee for Teaching Ethics Across the Curriculum (TEAC) 2001-2002
Assoc. Vice Chancellor for Research and Graduate Studies, 2001-2002
Departmental Graduate Recruiting Committee (2003-present)
University Task Force on Postdoctoral Students (2004)
Departmental Awards Committee (2004-2008)
Committee on Responsible Conduct of Research (2007-present)
Biotechnology Training and Education Center Advisory Board (2008-2015)
Biotechnology Training and Education Center Curriculum Committee (2008-2015)
Genome Science Lab Advisory Committee (2008-2011)
University Task Force on Biological Imaging (2010-2012)
Co-Chair, University Task Force on Comprehensiveness and Interdisciplinarity (2010-2011)
Search Committee, Cluster Hire in Systems and Synthetic Biology (2012-2015)
Search Committee, Cluster Hire in Microbiomes (2015-2018)
Search Committee, Metabolic Engineering, Biological & Agricultural Engineering (2017-2018)
Faculty Advisory Board, NCSU METRIC (2018-present)
Advisory Committee, NSF AgBioFEWS Program (2018-present)
University Task Force on Interdisciplinarity (2020-present)

Consulting:

Brooklyn Union Gas Company; Teledyne Energy Systems; McCormick Food Company; SAFT Battery; Smith, Kline and French Laboratories; Davison Chemical (W.R. Grace); Energetics, Inc.; Bioindustrial Technologies Incorporated; Schering-Plough Corporation; Union Carbide; Burroughs Wellcome; Dowell Schlumberger; FMC; Kraft; DuPont; US Department of Energy; National Renewable Energy Laboratory; Stratagene Cloning Systems; Diversa Corp.; US National Institutes of Health; Duke University; Rohm and Haas; Syngenta ; Cargill; New England Biolabs; BD Technologies; University of California-Riverside; Harvard Management Company; Montana State University; Novozymes

MASTER'S STUDENTS

Student	B.S. Degree	Grad. Degree	Thesis Topic	Last Known/Current Employment
1. David Sherry	Johns Hopkins	M.S., 1983 (JHU)	The effects of diffusion and intrinsic kinetics on production rate of aspartic acid by aspartase in <i>Escherichia coli</i>	Anheuser-Busch, St. Louis, MO
2. John Godshalk	N.C. State	M.S., 1984 (JHU)	Characterization of bacteria from extreme environments	The Biologics Consulting Group, Alexandria, VA
3. Stuart A. Hurwitz	Maryland (Chemistry)	M.S., 1985 (JHU)	The effects of temperature and pressure on the growth of the extreme thermophile <i>Sulfolobus acidocaldarius</i>	IBM, RTP, NC
4. Francis J. Sturm	Coast Guard Academy (Chemistry)	M.S., 1986 (JHU)	Growth of extremely thermophilic archaeobacteria in a hyperbaric helium bioreactor	U.S. Coast Guard, Homeland Security. Washington, DC
5. A.K. Parameswaran	IIT-Kanpur	M.S., 1987 (JHU)	Extremely thermophilic archaeobacteria of the genus <i>Pyrodictium</i> : Effect of yeast extract and hydrogen and carbon dioxide partial pressures on growth and sulfide production	Cognizant Technology Solutions, Wash., DC
6. Wei-wen (Winston) Su	NTU, China	M.S., 1987 (JHU)	Engineering studies of extremely thermophilic archaeobacteria: <i>Sulfolobus acidocaldarius</i> and <i>Pyrococcus furiosus</i>	Department of Molecular Biosciences and Bioengineering, University of Hawaii
7. Balrina Malik	IIT-New Dehli (Chemistry)	M.S., 1988 (JHU)	Growth and gas production for the extremely thermophilic archaeobacterium: <i>Pyrococcus furiosus</i>	Schering-Plough, Union, NJ
8. Anne Robinson	Johns Hopkins	M.S., 1989 (JHU)	Isolation and characterization of proteolytic enzymes from the hyperthermophilic archaeobacterium, <i>Pyrococcus furiosus</i>	CHE (Dept. Head), Tulane University
9. Henry Costantino	Johns Hopkins	M.S., 1989 (JHU)	Isolation and characterization of amylolytic enzymes from the hyperthermophilic archaeobacterium, <i>Pyrococcus furiosus</i>	Alkermes, Inc., Waltham, MA
10. Jeffrey Schuliger	Bucknell	M.S., 1991 (JHU)	Growth physiology and biochemical studies of a novel, deep sea hyperthermophilic archaeobacterium, ES4	US Army, Aberdeen, MD
11. Lesley Snowden-Swan	Washington	M.S., 1991 (JHU)	Characterization of metabolic patterns in the hyperthermophilic archaeobacterium, <i>Pyrococcus furiosus</i>	PNNL, Richland, WA
12. V. Muralidharan	IIT-Madras	M.S., 1992 (JHU)	Interspecies hydrogen transfer in cocultures of extremely thermophilic bacteria	BHP Billiton, Houston, TX

13. Olga D'Hennezel	UTC, France	M.S., 1993 (NCSU)	Characterization of a novel thermostable DNA polymerase from a hydrothermal vent microorganism	Merck & Co., Durham, NC
14. Pascal Leduc	UTC, France	M.S., 1994 (NCSU)	Purification and characterization of an α -galactosidase and an exo- β -mannanase from the hyperthermophilic eubacterium <i>Thermotoga neapolitana</i> strain 5068	Bonduelle, Quebec, Canada
15. Rockey Bandlish	Ohio State (Biochem.); Emory (Pharmacy) (M.S.)	M.S., 1998 (NCSU)	Comparative study of glucose isomerases from the mesophile <i>Streptomyces murinus</i> and hyperthermophile <i>Thermotoga neapolitana</i> for high fructose corn syrup production	Illumina, San Diego, CA
16. Lance Driskill	Louisiana Tech	M.S., 1998 (NCSU)	Beta-specific glycosyl hydrolases from the hyperthermophilic archaeon <i>Pyrococcus furiosus</i> and their role in utilizing carbohydrate nutrient sources	MD, Wake Forest Univ., Diagnostic Radiology, Plano, TX
17. Jun Gao	Florida	M.S., 1999 (NCSU)	Characterization of a hyperthermophilic chitinase and its binding domain	TVS, Inc., RTP, NC
PH.D. STUDENTS				
1. Craig N. Schubert	UCSD	Ph.D., 1988 (JHU)	Experimental studies of selective acid gas removal	Dow Global Technologies, Midland, MI
2. John R. Lindner	Johns Hopkins	Ph.D., 1988 (JHU)	Mathematical model for selective chemical absorption of H ₂ S from CO ₂ in packed columns	Lockheed Martin Space, Denver, CO
3. Ilse I. Blumentals	Simon Bolivar, Caracas, VZ (Biology)	Ph.D., 1990 (JHU); Postdoc, 1991	Characterization of growth physiology, cell-sulfur interaction and SDS-resistant proteolytic activity in the hyperthermophilic archaeobacterium <i>Pyrococcus furiosus</i>	Cellgene Corp., Summit, NJ
4. Richard N. Schicho	Duke (Chemistry)	Ph.D., 1992 (JHU)	Bioenergetic studies of sulfur reduction in the hyperthermophilic archaeobacteria <i>Pyrodictium brockii</i> and <i>Pyrococcus furiosus</i>	Takeda, Oxford, GA
5. Stephen H. Brown	Maryland- College Park	Ph.D., 1992 (JHU)	Saccharidases from high-temperature bacteria: Physiological and enzymological studies	Novozymes Biotech, Davis, CA
6. Tonya L. Peeples	N.C. State	Ph.D., 1994 (JHU)	Bioenergetic studies of hyperthermophilic and extremely thermoacidophilic archaea as related to coal desulfurization	Assoc Dean of Engineering, U Iowa

7. Sheryl Halio Bauer	Tufts	Ph.D., 1995 (NCSU)	Cloning, sequencing, expression and physiological characterization of protease S66 from the hyperthermophile <i>Pyrococcus furiosus</i>	Akcea Therapeutics, Cambridge, MA
8. J. Michael Hess	Grove City College Penn State (M.S.)	Ph.D., 1997 (NCSU); Postdoc 1998	Thermostabilization and thermoactivation of free and immobilized xylose isomerases from hyperthermophilic microorganisms	Novozymes, Franklinton, NC
9. Michael W. Bauer	Cornell	Ph.D., 1997 (NCSU)	Hemicellulases from hyperthermophilic archaea: Genetic, biomolecular, physiological and engineering characterization	Syngene BioPharma Corp., Lexington, MA
10. Kristina D. Rinker	Alabama	Ph.D., 1998 (NCSU)	Bioenergetic and physiological studies of hyperthermophilic archaea	Assoc. Prof., Department of Physiology and Pharmacology, U Calgary
11. Chae Han	UT-Austin	Ph.D., 1998 (NCSU)	Physiological studies of extremely thermoacidophilic microorganisms under normal and stressed conditions	Amgen, Newbury Park, CA
12. Paula M. Hicks	Dayton	Ph.D., 1998 (NCSU)	Genetic, biochemical, and biophysical characteristics of intracellular proteases from the hyperthermophilic archaeon <i>Pyrococcus furiosus</i> and the hyperthermophilic bacterium <i>Thermotoga maritima</i>	Nootkatobe, Evolva, Inc., San Francisco, CA
13. Kimberley Rollins Parker	NC A&T; NC State (M.S.)	Ph.D., 2000 (NCSU)	Biochemical and physiological characterization of α - and β -specific galactomannan-degrading enzymes from hyperthermophilic microorganisms	Novo Nordisk, Clayton, NC
14. Amitabh C. Sehgal	NC State	Ph.D. 2002 (NCSU)	Effect of reaction environment on biocatalysis and enantioselectivity of hyperthermophilic esterases	Fujifilm Diosynth Biotechnologies, RTP, NC
15. Swapnil R. Chhabra	IIT Bombay	Ph.D. 2002 (NCSU)	Physiological, biochemical, and biotechnological characterization of glycoside hydrolases from the hyperthermophilic bacterium <i>Thermotoga maritima</i>	IBM: Watson Health, Chicago, IL
16. Marybeth Pysz	SUNY Buffalo	Ph.D. 2003 (NCSU)	Transcriptional analysis of biofilm formation and stress response in hyperthermophilic microorganisms	AbbVie Stemcentrx, South San Francisco, CA
17. Lara S. Madding	University of Virginia	Ph.D. 2003 (NCSU)	Role of β 1 subunit in function and stability of the 20S proteasome from the hyperthermophilic archaeon <i>Pyrococcus furiosus</i>	Greenology Products, Inc., Raleigh, NC
18. Keith R. Shockley	New Mexico State	Ph.D. 2004 (NCSU)	Functional genomics investigation of microbial physiology in the hyperthermophilic microorganisms <i>Pyrococcus furiosus</i> and <i>Thermotoga maritima</i>	NIEHS, RTP, NC

19. Kevin L. Epting	Penn State N.C. State (M.S.)	Ph.D. 2004 (NCSU)	Xylose (glucose) isomerases from <i>Thermotoga</i> species: Biochemical, biophysical and bioprocessing issues	Sartorius, Harrisburg, PA
20. Clemente Montero	Simon Bolivar, Caracas, VZ (Biology)	Ph.D. 2005 (NCSU)	Molecular microbial ecology of the hyperthermophilic bacterium <i>Thermotoga maritima</i> : Transcriptional and physiological response to antibiotic challenge and inter-species interactions	Clarus, Syracuse, NY
21. Shannon B. Conners	Mt. Holyoke College (Biochem.)	Ph.D. 2005 (NCSU)	Carbohydrate utilization pathway analysis in the hyperthermophile <i>Thermotoga maritima</i>	SAS Institute, Cary, NC
22. Matthew R. Johnson	Cornell U (Biol Engr)	Ph.D. 2005 (NCSU)	Intercellular communication in hyperthermophilic microorganisms	Duke Vaccine Center, Durham, NC
23. Donald A. Comfort	Case Western	Ph.D. 2006 (NCSU)	Discovery, functional genomics, and characterization of alpha-specific glycosyl hydrolases from hyperthermophilic microorganisms	Assoc. Prof., Department of Chemical and Materials Engineering, U Dayton
24. Joshua R. Michel	UC-Davis	Ph.D. 2007 (NCSU)	Identification, characterization, and physiologic analysis of proteolytic enzymes from hyperthermophilic microorganisms	DuPont, Palo Alto, CA
25. Chung-Jung (Hank) Chou	NTU Taiwan	Ph.D. 2007 (NCSU)	Functional genomics analysis of biohydrogen production by hyperthermophilic microorganisms	Prof., Chung-Yuan Christian Univ., Taiwan
26. Sabrina Tachdjian	Univ. of Lyon, France	Ph.D. 2007 (NCSU)	Functional genomics of stress response in the hyperthermophilic crenarchaeon <i>Sulfolobus solfataricus</i> and role of <i>vapBC</i> Toxin-Antitoxin loci in RNA management	Samsung, Seoul, Korea
27. James M. Harris	N.C. A&T	Ph.D. 2009 (NCSU)	Biochemical and biophysical characterization of hyperthermophilic sugar epimerases and isomerases	Pfizer, Sanford, NC
28. Steven R. Gray	UVa	Ph.D. 2009 (NCSU)	Functional Genomics Analysis of Carbohydrate Conversion to Biohydrogen by Pure and Mixed Cultures of Hyperthermophilic <i>Thermotoga</i> Species	Regulatory Coordinator, Duke Cancer Institute, Durham, NC
29. Kathryn S. Auernik	Notre Dame	Ph.D. 2009 (NCSU)	Functional genomics analysis of metal mobilization by the extremely thermoacidophilic archaeon <i>Metallosphaera sedula</i>	Pfizer, Sanford, NC
30. Amy L. VanFossen	Delaware	Ph.D. 2009 (NCSU)	Carbohydrate utilization in the extremely thermophilic bacterium <i>Caldicellulosiruptor saccharolyticus</i>	Axcella, Cambridge, MA
31. Derrick L. Lewis	South Alabama	Ph.D. 2010 (NCSU)	Functional Genomics Analysis of Extremely Thermophilic Fermentative Microorganisms from the	Novozymes Biologicals, Inc., RTP, NC

			Archaeal Genus <i>Pyrococcus</i> and Bacterial Genus <i>Caldicellulosiruptor</i>	
32. Charlotte R. Cooper	South Carolina	Ph.D. 2011 (NCSU)	VapBC Toxin-Antitoxin Loci in the Extreme Thermoacidophile <i>Sulfolobus solfataricus</i> : Regulation of and Functional Biochemical Roles during Thermal Stress Response	Bluebird Pharma, RTP, NC
33. Inci Ozdemir	Middle Eastern U., Turkey	Ph.D. 2012 (NCSU)	Novel S-layer homology domain glycoside hydrolases from extremely thermophilic <i>Caldicellulosiruptor</i> spp.	Pfizer, St. Louis, MO
34. Andrew D. Frock	Virginia Tech	Ph.D. 2013 (NCSU)	Biohydrogenesis in the Thermotogales	Novozymes, Franklinton, NC
35. Jaspreet S. Notey	Birla Institute of Science & Technology-Pilani	Ph.D. 2013 (NCSU)	Microbial Physiology Studies of Hyperthermophilic Microorganisms: Functional Genomics Analysis of Post-Exponential Growth and Biochemical Specificity of Ribonucleolytic VapC and HicA Toxins	Lonza, Portsmouth, NH
36. Arpan Mukerjee	IIT Madras	Ph.D. 2014 (NCSU)	Functional genomics and Biochemical characterization of Uranium biooxidation and stress response in extremely thermoacidophilic <i>Metallosphaera</i> species	Precision Biosciences, Durham, NC
37. Hong Lian	East China U	Ph.D. 2014 (NCSU)	Transcriptomic and Physiological Analysis of a Recombinant <i>Pyrococcus furiosus</i> Strain Metabolically Engineered to Produce 3-Hydroxypropionate from CO ₂ and Maltose	School of Public Health, Xiamen University, China
38. Aaron Hawkins	Macalester College	Ph.D. 2014 (NCSU)	Elucidation and Implementation of a Thermophilic Carbon Fixation Cycle for Electrofuels Metabolic Engineering	Novozymes, Franklinton, NC
39. Andrew Loder	Rose-Hullman Inst.	Ph.D. 2016 (NCSU)	Genome Engineering of Extremely Thermophilic Microorganisms for Biofuels Production	Novozymes, Franklinton, NC
40. Jeffrey Zurawski	Colorado State Univ.	Ph.D. 2016 (NCSU)	Plant biomass deconstruction by extremely thermophilic <i>Caldicellulosiruptor</i> species	Amgen, San Juan, Puerto Rico
41. Garrett Wheaton	University of Virginia	Ph.D. 2016 (NCSU)	Heavy metal biooxidation and resistance mechanisms in extremely thermoacidophilic archaea	MJ Woolly Biotech, Chico, CA
42. Jonathan Conway	Notre Dame	Ph.D. 2017 (NCSU)	<i>In Vitro</i> and <i>In Vivo</i> Analyses of the Role of Multi-Domain Glycoside Hydrolases from Extremely Thermophilic <i>Caldicellulosiruptor</i> Species in the Degradation of Plant Biomass	Postdoc, UNC-CH (Biology)
43. Benjamin Zeldes	Univ. of Pittsburgh	Ph.D. 2018 (NCSU)	Leveraging Extreme Thermoacidophily for Archaeal Metabolic Engineering	Postdoc, University of Rostock, Germany
44. Laura Lee	Highpoint Univ.	Ph.D. 2018 (NCSU)	Biodiversity of and Lignocellulosic Modes of Action by the Extremely Thermophilic <i>Caldicellulosiruptor</i>	Novozymes, Franklinton, NC

45. James Counts	U Florida	Ph.D. 2019 (NCSU)	Microbial Metal Biooxidation by Thermoacidophilic Archaea	Postdoc, NC State Biotechnology Program
46. Christopher Straub	Penn State	Ph.D. 2019 (NCSU)	Metabolic Engineering for Bioproduct Formation at High Temperatures	Novozymes Biologicals, RTP, NC
47. James Crosby	University of Virginia	Ph.D. (NCSU)	Metabolic Engineering of Extreme Thermophiles for Lignocellulose Conversion	Current
48. Tunyaboon Laemthong	Kasetsart Univ (Bangkok, Thailand) (BS); Missouri Inst. Science & Tech. (MS)	Ph.D. (NCSU)	Plant Biomass Conversion to Industrial Chemicals	Current
49. Ryan Bing	Purdue	Ph.D. (NCSU)	Transgenic Poplar Conversion to Industrial Chemicals	Current
50. Daniel Willard	Bucknell	Ph.D. (NCSU)	Sulfur Chemolithotrophy in Extremely Thermoacidophilic Archaea	Current

POSTDOCTORAL STUDENTS / VISITING SCIENTISTS

Student	Previous Training	Period	Research Topic	Employment
Ilse I. Blumentals	Johns Hopkins (Ph.D., 1990)	1990-92	Hyperthermophilic consortia	GSK, Philadelphia, PA
Guy Duffaud	VPI (Ph.D., 1986)	1991-97	Hyperthermophilic glycosidases and DNA polymerases	Animal vaccines, Caracas, VZ
J. Michael Hess	NC State (Ph.D., 1997)	1997-98	Xylose isomerases	Novozymes, Franklinton, NC
Hong Chen	Duke (Ph.D., 1996)	1997-2000	Biocatalysis in nonaqueous solvents	University of Silicon Lake, China
Susan Cady	South Carolina (Ph.D., 1995)	1998-99	Hyperthermophilic glycosidases	NC State, Chemistry
Hak-sung Kim	KAIST, South Korea (Professor)	1997-1999	Hyperthermophilic hydantoinases	KAIST, Seoul, Korea
Stephen Chang	Virginia (Ph.D., 1998)	1998-2000	Hyperthermophilic amylases	Medimmune, Gaithersburg, MD
Edward S. Miller, Jr.	NC State (Ph.D., 1999)	1999-2000	Hyperthermophilic enzymes in transgenic plants	DuPont, Wilmington, DE

Donald E. Ward	Wake Forest (Ph.D., 1997) Wageningen University, The Netherlands (Postdoc, 1997-2000)	2000-2001	Hyperthermophilic proteases; cDNA microarrays	DuPont, New Century, KS
Leon Kluskens	Wageningen University (Doctoral student)	2000-2001	Hyperthermophilic pectinases; cDNA microarray studies	Univ of Minho, Braga Portugal
Shannon B. Conners	NC State (Ph.D. Genomics Sciences, 2005)	2005-2006	Bioinformatics analysis of DNA microarray data	SAS Corp., Cary, NC
Jason D. Nichols	Duke University (Ph.D., 2004)	2005-2007	Quorum sensing in hyperthermophiles; biofuels	Syngenta Corp., RTP, NC
Sara Blumer-Schuetz	Michigan State U (Ph.D., 2006)	2008-2014	Microbial ecology and bioenergy; <i>Caldicellulosiruptor</i> species	Asst Prof, Biological Sciences, Oakland Univ.
Yejun Han	Chinese Acad of Sciences (Ph.D., 2008); Postdoc, Energy Biosci Instit., UIUC (2008-10)	2010-2013	Electrofuels; Microbial biochemistry of <i>Metallosphaera</i> CO ₂ fixation	Assoc Prof., Chinese Acad. Sci., Beijing, China
Stephanie Bridger	Univ. Georgia (Ph.D., 2012)	2012	<i>Pyrococcus furiosus</i> metabolic engineering	Asuragen, Austin, TX
Carlos Goller	Emory Univ. (Ph.D., 2009; Postdoc Duke Univ., 2009-2011)	2012-2015	Teaching Postdoctoral Fellow – NC State Biotechnology Program (Metabolic Engineering, Metagenomics)	Asst. Prof., Biological Sciences, NCSU
Laura Ott	NC State (Ph.D., 2010); Postdoc UNC-CH (2010-2011)	2012-2015	Teaching Postdoctoral Fellow – NC State Biotechnology Program (Immunology)	Program Coordinator, Univ. Maryland – Baltimore County
Thomas Lentz	Univ. Wisconsin-Madison (Ph.D., 2011); Postdoc UNC-CH (2011-2014)	2014-2017	Teaching Postdoctoral Fellow – NC State Biotechnology Program (Virology)	Promega, Madison, WI
Javier Izquierdo	U Mass (PhD 2008)	2014	Metagenomics of <i>Caldicellulosiruptor</i> sp.	Asst. Prof., Biological Sciences, Hofstra Univ.
Piyum Khatibi	Virginia Tech (PhD 2011)	2014-2017	Lignocellulose bioconversion mechanisms	Novozymes Biologicals, RTP, NC
Nicholas Vitko	UNC-CH (PhD 2015)	2015-2016	Heavy metal biotransformations with thermoacidophilic archaea	Research Scientist, Pfizer, Sanford, NC
Jonathan Conway	NCSU (PhD 2017)	2017	Glycoside hydrolases from <i>Caldicellulosiruptor</i>	Postdoc – UNC-CH, Biology
Eric Lazear	U Penn	2018-2019	Teaching Postdoctoral Fellow – NC State Biotech. Program (Protein Engr)	Postdoc – UNC-CH, Biology
April Lewis	U Florida	2018-	Extremely Thermoacidophilic Archaea	Current
James Counts	NCSU (PhD 2019)	2020-	Extreme Thermoacidophiles	Current