

Mark Akeson

Ph.D.

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Professional Experience

- *Adjunct Associate Professor*
Biomolecular Engineering Department
Baskin School of Engineering
University of California, Santa Cruz, California
July 2004-Present
- *Research Specialist in Biophysics & Bioengineering*
Howard Hughes Medical Institute
Center for Biomolecular Science & Engineering
University of California, Santa Cruz, California
April 2001-July 2004
- *Associate Research Chemist, Step I*
Department of Chemistry & Biochemistry
University of California, Santa Cruz, California
2002-2003
- *Assistant Research Chemist*
Department of Chemistry & Biochemistry
University of California, Santa Cruz, California
1996-2001
- *Post-Doctoral Fellow in Molecular Biology*
National Institutes of Health, Bethesda, Maryland
Advisor, Dr. James F. Battey, Director, National Institute on Deafness and Other Communicative Disorders.
1990-1996

Education

- Ph.D. in Soil Microbiology, University of California, Davis. Dissertation Title: *Reactions of Aluminum at Lipid Bilayer Surfaces*. Advisors: Drs. Donald Munns, Richard Burau, and Mary K. Firestone. Manuscripts comprising this dissertation have been cited over eighty times in the scientific literature
- B.A. in 20th Century European History, Minor in Biology, Revelle College, University of California, San Diego

Research Interests

- *Design of single molecule biosensors based on nanoscale pores*. These devices use machine learning algorithms to automatically discriminate among single DNA molecules at 3 Å precision in real time
- *Use of the bacterial toxin, α -hemolysin, as a model pore for examination of the primary and secondary structure of nucleic acids*. These experiments have revealed details about HIV duplex DNA structure and dynamics that cannot be observed using other experimental approaches
- *Structure and function of G-protein-coupled receptors*. In collaboration with Stephen Winters-Hilt, we are using whole genome comparisons to elucidate transcription factor binding sites for this important protein super-family

Professional Honors & Appointments

- *Member*, the California Institute for Quantitative Biomedical Engineering (QB3). University of California **2001**-Present
- *Member*, Special Emphasis Panel on *Proteomics, Protein Expression, and Protein Therapeutics*, Center for Scientific Reviews, National Institutes of Health, Bethesda, Maryland **2001**-Present
- *Member*, Special Emphasis Panel on *Biosensors*, Division of Extramural Grants, National Science Foundation, Arlington, Virginia **2001**
- *Invited Participant*, Special Emphasis Panel on *Sequencing and Resequencing the Biome*, National Human Genome Research Institute (NHGRI), Bethesda, Maryland, July **2001**
- *Research Excellence Award*, National Institute on Deafness and Other Communication Disorders, Bethesda, Maryland, **1997**

Grant Support

- Author and Co-Principal Investigator with David Deamer on a grant funded by the National Human Genome Research Institute through July 2001. Title: *Rapid Sequencing of Nucleic Acids Using a Nanoscale Pore*
- Co-Principal Investigator with David Deamer on a grant funded by the National Human Genome Research Institute through July 2006. Title: *Rapid Sequencing of Nucleic Acids Using a Nanoscale Pore*
- Co-recipient with David Deamer of a \$40,000 gift from Agilent Technologies to support fundamental studies on nanopore technology

Patents

- *Characterization of Individual Polymer Molecules Based on Monomer-Interface Interactions*, U.S. Patent No. 5,795,782. Licensed to Agilent Technologies, Palo Alto, California
- *Miniature Support for Thin Films Containing Single Channels or Nanopores and Methods for Using Same*, U.S. Patent No. 6,267,872
- *Targeted Molecular Bar Codes and Methods for Using Same.*, U.S. Patent No. 6,465,193 B2
- *A Nanopore Instrument for Reading the Ends of Individual DNA Duplex Molecules*. University of California Case No. 2000-465-1, Patent Pending

Invited Seminars, 1999 to Present

1. *Structure and Dynamics of Individual DNA Molecules at One Base-Pair Resolution in Real Time*. Symposium on Single Molecule Diagnostic Assays, PITTCON, Chicago, Illinois, March 9, **2004**.
2. *Analysis of Individual DNA Molecules at Angstrom Precision Using a Nanoscale Pore*. Department of Chemistry & Biochemistry, University of California, Santa Cruz, California, October 13, **2003**.
3. *Nanoscale Protein Pores in Basic Science & Engineering*, School of Engineering, University of California, Santa Cruz, California, May 5, **2003**
4. *Comparative Genomics of Mouse & Human G-Protein-Coupled Receptors*, Gordon Research Conference on Molecular Pharmacology, Ventura, California, February 11, **2003**
5. *Sequence-Dependent Fraying of Single DNA Molecules*, California Institute for Quantitative Biomedical Research (QB3), Santa Cruz, California, December, 8, **2002**
6. *Single Molecule Biophysics: New Tools for DNA Technology*, Department of Physics, University of California, Santa Cruz, California, April 10, **2002**

7. *Discrimination Between Watson-Crick Base Pairs in Single DNA Molecules Using an Ion Channel*, Section on Single Molecule Biophysics, American Physical Society, Indianapolis, Indiana, March 19, **2002**
8. *Discrimination Between Watson-Crick Base Pairs in Single DNA Molecules Using an Ion Channel*, Section on Single Molecule Spectroscopy, Federation of Analytical Chemistry and Spectroscopy Societies, Detroit Michigan, October 12, **2001**
9. *Discrimination Between Watson-Crick Base Pairs in Single DNA Molecules Using an Ion Channel*, NIH Symposium on Nanopore Technology, Bethesda, Maryland, April 17, **2001**
10. *High Speed Analysis of Single DNA Molecules*, Center for Biomolecular Science and Engineering, University of California, Santa Cruz, California, January 23, **2001**
11. *Analysis of Targeted Molecular Bar Codes Using a Nanopore Device*, Incyte Pharmaceuticals, Palo Alto, California, April 21, **1999**
12. *Use of a Nanoscale Pore to Read Short Segments Within Single Polynucleotide Molecules*, NATO Advanced Research Workshop on Polymer Structure and Transport in Confined Spaces, Bikal, Hungary, June 24, **1999**
13. *Use of a Nanoscale Pore to Read Short Segments Within Single Polynucleotide Molecules*, Physics Department, University of British Columbia, Vancouver, Canada, September 24, **1999**
14. *Analysis of Targeted Molecular Bar Codes Using a Nanopore Device*, Agilent Corporation, Palo Alto, California, October 7, **1999**

Publications

1. Nakane JJ, Akeson M., and Marziali, A. "Nanopore sensors for nucleic acid analysis." *Journal of Physics-Condensed Matter*, **2003**. 15(32): R1365-R1393.
2. Winters-Hilt S, Vercoutere W, DeGuzman VS, Deamer D, **Akeson M**, Haussler D. Highly accurate classification of Watson-Crick base pairs on termini of single DNA molecules. *Biophysical Journal*, **2003**. 84:967-976.
3. Vercoutere WA, Winters-Hilt S, DeGuzman VS, Deamer D, Ridino SE, Rodgers JT, Olsen HE, Marziali A, **Akeson M**: Discrimination among individual Watson-Crick base pairs at the termini of single DNA hairpin molecules. *Nucleic Acids Research*. **2003**. 31:1311-1318.
4. Vercoutere W. & **Akeson M**. Biosensors for DNA sequence detection. *Current Opinion in Chemical Biology*, **2002**. 6:816-822.
5. Nakane J., **Akeson M**, and Marziali A. Evaluation of nanopores as candidates for electronic analyte detection. *Electrophoresis*, **2002**. 23:2592-2601.
6. **Akeson M**, Deamer DW, Vercoutere W, Braslau R, Olsen H. *Use of a nanoscale pore to read short segments within single polynucleotide molecules*, pp. 187-200 In, *Structure and Dynamics of Confined Polymers*, J. Kasianowicz, M. Kellermayer, and D. Deamer Editors. Bikal, Hungary, **2002**.
7. Deamer DW, Olsen H, **Akeson MA**, Kasianowicz J. *Mechanism of ionic current blockades during polymer transport through pores of nanometer dimensions*, pp.165-176 In, *Structure and Dynamics of Confined Polymers*, J. Kasianowicz, M. Kellermayer, and D. Deamer Editors. Bikal, Hungary, **2002**.
8. Vercoutere W., Winters-Hilt S, Olsen H, Deamer D, Haussler D, **Akeson M**. Rapid discrimination among individual DNA hairpin molecules at single nucleotide resolution using an ion channel. *Nature Biotechnology*, **2001**. 19(3): 248-252.

9. Marziali A. and **Akeson** MA. New DNA Sequencing Methods. *Annual Review in Biomedical Engineering*, **2001**. 3:195-223.
10. Deamer DW, and **Akeson** M. Nanopores and nucleic acids: prospects for ultra-rapid sequencing. *Trends in Biotechnology*, **2000**. 18(4): p. 147-151.
11. Paula S, **Akeson** M, and Deamer DW. Water transport by the bacterial channel alpha-hemolysin. *Biochimica Et Biophysica Acta-Biomembranes*, **1999**. 1418(1): p. 117-126.
12. **Akeson** MA, Branton D, Kasianowicz JJ, Brandin E, Deamer DW. Microsecond time-scale discrimination among polycytidylic acid, polyadenylic acid, and polyuridylic acid as homopolymers or as segments within single RNA molecules. *Biophysical Journal* **1999**.77: 3227-3233.
13. Donohue PJ, Sainz E, **Akeson** M, Kroog GS, Mantey S, Battey JF, Jensen RT, and Northup JK. An aspartate residue at the extracellular boundary of TMII and an arginine residue in TMVII of the gastrin-releasing peptide receptor interact to facilitate heterotrimeric G-protein coupling. *Biochemistry* , **1999** 38(29), 9366-9372.
14. Katsuno T, Pradhan TK, Ryan RR, Mantey SA, Hou W, Donohue PJ, **Akeson** MA, Spindel ER, Battey JF, Coy DH, and Jensen RT. Pharmacology and Cell Biology of the Bombesin Receptor Subtype 4 (BB4-R), *Biochemistry*, **1999** 38(22), 7307-7320.
15. Sainz E, **Akeson** M, Mantey SA, Jensen RT, and Battey JF. Four amino acids are critical for high affinity binding of neuromedin B to the neuromedin B receptor. *Journal of Biological Chemistry*, **1998**, 273: 15927-15932.
16. Hampton L, Ladenheim EE, **Akeson** M, Way JM, Weber HC, Sutliff VE, Jensen RT, Wine LJ, Arnheiter H, Battey JF. Loss of bombesin-induced feeding suppression in gastrin- releasing peptide receptor deficient mice. *Proceedings of the National Academy of Sciences (PNAS)* **1998**, 95: 3188-3192.
17. Mantey SA, Weber CH, Sainz E, **Akeson** M, Ryan RH, Pradhan TK, Searles RP, Spindel ER, Battey JF, Coy DH, Jensen, RT. Discovery of a high affinity radioligand for the human orphan receptor, bombesin receptor subtype 3, which demonstrates that it has a unique pharmacology compared with other mammalian bombesin receptors. *Journal of Biological Chemistry*, **1997** Jul 11, 272(41):26062-26071.
18. **Akeson** M, Sainz E, Mantey SA, Jensen RT, Battey JF. Identification of four amino acids in the gastrin-releasing peptide receptor that are required for high affinity agonist binding. *Journal of Biological Chemistry*, **1997** Jul 11, 272(28):17405-9.
19. Tsuda T, Kusui T, Hou W, Benya RV, **Akeson** MA, Kroog GS, Battey JF, Jensen RT. Effect of gastrin-releasing peptide receptor number on receptor affinity, coupling, degradation, and modulation. *Molecular Pharmacology*, **1997** May, 51(5):721-32.
20. Kroog GS, Sainz E, Worland PJ, **Akeson** MA, Benya RV, Jensen RT, Battey JF. The gastrin-releasing peptide receptor is rapidly phosphorylated by a kinase other than protein kinase C after exposure to agonist. *Journal of Biological Chemistry*, **1995** Apr 7, 270(14):8217-24.
21. Benya RV, **Akeson** M, Mrozinski J, Jensen RT, Battey JF. Internalization of the gastrin-releasing peptide receptor is mediated by both phospholipase C-dependent and -independent processes. *Molecular Pharmacology*, **1994** Sep, 46(3):495-501.
22. Deamer DW, **Akeson** MA. The role of water in proton conductance across model and biological membranes. pp 41-54 in *Biomembrane Electrochemistry*, ACS Advances in Chemistry Series No. 235, **1994**, M. Blank and I. Vodyanoy, Editors.

23. Bogner P, Skehan P, Kenney S, Sainz E, **Akeson** MA, Friedman SJ. Stabilization of intercellular contacts in MDCK cells during Ca^{2+} deprivation. Selective effects of monocarboxylic acids on desmosomes. *Journal of Cell Science*, **1992** Oct, 103 (Pt 2):463-73.
24. **Akeson** M, Scharff J, Sharp CM, Neville DM Jr. Evidence that plasma membrane electrical potential is required for vesicular stomatitis virus infection of MDCK cells: a study using fluorescence measurements through polycarbonate supports. *Journal of Membrane Biology*, **1992** Jan, 125 (1):81-91.
25. Oliver AE, Deamer DW, **Akeson** M. Evidence that sensitivity to steroid anesthetics appears late in evolution. *Brain Research*, **1991** Aug 23, 557(1-2):298-302.
26. **Akeson** M, Deamer DW. Proton conductance by the gramicidin water wire. Model for proton conductance in the F1F0 ATPases? *Biophysical Journal*, **1991** Jul, 60(1):101-9.
27. **Akeson** M; Deamer DW. Anesthetics and membranes: A critical review. *Advances in Membrane Fluidity*, **1991** 4:71-89.
28. Oliver AE; Deamer DW; **Akeson** M. Sensitivity to anesthesia by pregnanolone appears late in evolution. *Annals of the New York Academy of Sciences* **1991**, 625:561-5.
29. **Akeson** MA, Munns DN. Uptake of aluminum into root cytoplasm: Predicted rates for important solution complexes. *Journal of Plant Nutrition*, **1991**, 13:467-484.
30. **Akeson** MA, Deamer DW. Steady-state catecholamine distribution in chromaffin granule preparations: A test of the pump-leak hypothesis of general anesthesia. *Biochemistry*, **1989**, 28: 5120-5127.
31. **Akeson** MA, Munns DN, Bura RG. Adsorption of Al^{3+} to phosphatidylcholine vesicles. *Biochimica Biophys Acta*, **1989** Nov 17, 986(1):33-40.
32. **Akeson** MA, Munns DN. Lipid bilayer permeation by neutral aluminum citrate and by three α -hydroxy carboxylic acids. *Biochim Biophys Acta*, **1989** Sep 4, 984(2):200-6.
33. **Nater** EA, Bura RG, Akeson MA. Fluoride matrix modifiers for the determination of Al by graphite furnace atomic absorption spectroscopy. *Analytica Chimica Acta*, **1989**, 225:233-239.
34. Gogan PJ, Jessup DA, **Akeson** M. Copper deficiency in tule elk at Point Reyes, California. *Journal of Range Management*, **1989**, 42: 233-238.