

Krishnan K. Chittur

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U.S. Citizen

Educational Background

- Ph.D. (Chemical Engineering) Rice University, Houston, Texas, 1984
(Advisor: Larry McIntire) (Dissertation: Effect of shear stresses on human lymphocyte function)
- B.Tech. (Chemical Engineering) Indian Institute of Technology, Bombay, India, 1979.

Professional Experience

- 2014 (May) - Chair, Chemical and Materials Engineering
- 2009 - President/CTO, GeneCapture, Inc. Huntsville, AL 35806
- 2008/2009 Visiting Scientist, **HudsonAlpha Institute for Biotechnology**, Huntsville, AL (academic sabbatical)
- 1999/2000 Visiting Scientist, Research and Development Department, Research Genetics, Huntsville, AL (academic sabbatical)
- 1999 - Professor, Chemical and Materials Engineering Department (*Promoted March 15, 1999*)
- 1999 -2003 Director, Biotechnology Science and Engineering Ph.D. Program.
- 1991-1999 Associate Professor, Chemical and Materials Engineering Department (*Tenure awarded, March 15, 1995*)
- 1990-1991 Senior Research Associate, Biomedical Engineering Department, Case Western Reserve University, Cleveland, Ohio.
- 1984-1990 Principal Research Scientist, National Center for Biomedical Infrared Spectroscopy, Battelle Columbus Laboratories, Columbus, Ohio.

Awards and Honors

- Research and Creative Achievement Award, UAH Foundation, March 1999.
- 1st Prize, Alabama Launchpad (Business Plan Competition), April 16, 2010

Current Research Areas

DNA microarrays, bioinformatics. Medical diagnostics.

Teaching Interests

Thermodynamics, Biochem/Biomedical Engineering, Design, Process Simulation, Bioinformatics. Open Source software (Google Summer of Code), **Ideas for Transforming Education**

Funding for Teaching Initiatives

1. A MOOC from UAH College of Engineering, Pilot offered Spring 2014, February 27 to May 12, 2014, October 7, 2014 to December 17, 2014
2. Google Summer of Code, support for students to work on ASCEND a free, open source software program for complex calculations and modeling. (*I am a developer and project team member*) (2009, 2010, 2011, 2012)
3. University of Alabama in Huntsville, Teaching Mini-Grant, \$2,000 (1997/8) (PI) Instructional Tools for Chemical Engineers (Tutorials on Aspenplus, development of departmental web pages for courseware)
4. \$5,000 Improving Student Access to Educational Materials, UAH MiniGrant, 1998/1999 (preparation of the Chemical Engineer's ToolBox – collection of useful software, courseware)

Consulting Activities

Process analysis and optimization, technical training for production line employees, Nektar Therapeutics, Inc.

Funded Research

1. Partnership for Biotechnology Research (Funding for PhD Student in Biotechnology Science and Engineering, 2008/09).
2. \$50,000 Universal detection of nucleic acids in complex mixtures, Consortium for Materials Development in Space (Funded by NASA, at the University of Alabama in Huntsville) Fall 2002 – Fall 2003
3. \$60,000 per year for three years – starting 1/2003. Malaria Bed-Nets (Centers for Disease Control, Atlanta, Georgia)
4. Design and Scale-Up of a Process for Recovery of a Recombinantly Produced Protease“, 10/1/99 to 9/30/01, (Co-Investigator with D.G. Hayes (UAH), C. G. Russell, and H. Zappe (Research Genetics) Subcontract within NSF-EPS-9977239, ”Development of an Integrated, State-Wide Effort in Metal Ion Pollution Prevention for Alabama Manufacturing Industries“, R. D. Rogers (Univ. Alabama-Tuscaloosa), PI. (Matching funds provided by Research Genetics, Inc., Huntsville, AL, a Division of Invitrogen, Carlsbad, CA).
5. Infrared Signatures for Mammalian Cells in Culture (NASA-NRA-96-OLMSA-03), \$432,000 (over 3.5 years, start Fall 1997, no cost extension till December 2002) (Principal Investigator)

6. \$14,700 Experimental Setup for Automated Protein Crystal Growth Experiments, NASA/MSFC, 5/15/99 - 12/31/99
7. \$10,000 Construction of hybrid device to measure electroosmosis and protein adsorption, Alabama Space Grant Consortium.
8. Gene Expression using cDNA Microarrays – Sabbatical Funding (partial), Research and Development Department, Research Genetics, Huntsville, AL.
9. FTIR for Peptide Analysis (Subcontract to Program Project Grant at Univ. of AL Birmingham, approximately \$25,000 per year, 5 years, start Fall 1997) (Co-Investigator)
10. Approximately 45K (per year, 1993-98) NSF-EPSCoR Grant, Biomaterials Technology Transfer (Co-Investigator, P.I.: Linda Lucas University of Alabama Birmingham)
11. \$25,000 (Shearwater Polymers Inc., Huntsville, AL), Polymers for Drug Delivery (Principal Investigator)
12. Approximately 300K (direct+indirect, over four years, April 1 1992 to September 1996) from the National Heart, Lung and Blood Institute: (**Principal Investigator**) A Molecular Level Approach to Blood Materials Interactions, HL 38936-07. (funding since 1987).
13. Alabama NSF EPSCoR Agency Visitation Award, \$900, Fall 1994 (Visit to NSF, NIH to speak with Program Managers)
14. Alabama NSF EPSCoR - Phase II (Surfaces Cluster) \$75,000 (direct plus indirect to my project), September 1992 through August 1995
15. NSF EPSCoR Phase II - Equipment - Purchase of an STM/AFM System, \$48,285 (total) -Co-Investigator with Jeffrey Weimer, Fall 1992.
16. Universities Space Research Association (USRA), Visiting Scientist at NASA/Johnson Space Center, June 19-August 11, 1995. Development of Biosensors for Space Bioreactors.
17. Approximately 35K (for a three month effort) subcontract from TRW, Inc. studying gelled propellant corrosion phenomena, ended December 1993.
18. University of Alabama in Huntsville, Mini-Grant Program: \$1,500 (1992) (Principal Investigator) Infrared spectroscopic techniques for bacterial identification.
19. Division of Research Resources, NIH, RR-01367, "A National Center for Biomedical Infrared Spectroscopy", Coinvestigator (P.I. Richard A. Dluhy); \$3,500,500 (approximate total direct costs), period of support 9/1/83 - 5/31/89 at Battelle Columbus Laboratories.

Patents Awarded

Nucleic acid detector and method for detecting targets within a sample – US Patent 7,291,459 (November 6, 2007) – Marc L. Pusey, Krishnan K. Chittur, Jeffrey J. Dowell and Joseph D. Ng

Patent Application

Countercurrent web contactor for use in separation of biological agents, October 2002 – Ramon L. Cerro, Douglas G. Hayes and **Krishnan Chittur** *Stopped pursuing the application and the claims in 2005*

Manuscripts

1. TMATCH: A New Algorithm for Protein Alignments using amino-acid hydrophobicities: David P Cavanaugh, Krishnan K. Chittur
2. A hydrophobic proclivity index for protein alignments: David P. Cavanaugh, Krishnan K. Chittur
3. Improving protein alignment algorithms using amino-acid hydrophobicities - Applications of TMATCH: David P Cavanaugh, Krishnan K. Chittur
4. Krishnan K. Chittur, Robert Zahorchak. Enzyme Kinetics: Theory and Experimentation, what students learn by doing.

Publications

1. Sanja Glisic, David P. Cavanaugh, Krishnan K. Chittur, Milan Sencanski, Vladimir Perovic and Tijana Bojic: Common molecular mechanism of the hepatic lesion and the cardiac parasympathetic regulation in chronic hepatitis C infection: a critical role for the muscarinic receptor type (BMC Bioinformatics, Accepted, January 2016)
2. David P. Cavanaugh, Krishnan K. Chittur: A hydrophobic proclivity index for protein alignments, Faculty of 1000 (Research) (In Press, September 2015)
3. Jonas Boateng, Robert Zahorchak, Joel Peek, Krishnan Chittur Novel stem-loop probe DNA arrays: Detection of specific acetotrophic 16S ribosomal RNA signatures, Analytical Biochemistry, Vol 435, pp 60–67 2013. [10.1016/j.ab.2012.12.006](https://doi.org/10.1016/j.ab.2012.12.006)
4. Jonas Boateng, Joel Peek, Robert Zahorchak, Krishnan Chittur Dendron modified surfaces provide an ideal environment for stem loop DNA probes, Analytical Biochemistry, Vol 430, pp 39–44, 2012. <http://dx.doi.org/10.1016/j.ab.2012.07.021>
5. Xhuang, Fei, Chittur, Krishnan, Mount, Dwight, Smith, Stephen, Hayes, Douglas Simple and Inexpensive Preparation of Long-Lasting Insecticidal Nets Via Co-Adsorption of Pyrethroid and Oligomer Textile Research Journal, Vol 78, Number 7, pp 595603 (July, 2008)
6. M. Elena Diaz, B. Johnson, **Krishnan K. Chittur**, Ramon L. Cerro (2005) Infrared Spectroscopy analysis of the structure of multilayer Langmuir-Blodgett Films: Effect of deposition velocity and pH: Langmuir, Vol 21(2), pp 610-6

7. Susan M. McCormick, S.R. Frye, Suzanne G. Eskin, Christina L. Teng, Chiung-Mei Lu, Christopher G. Russell, **Krishnan K. Chittur**, Larry V. McIntire (2003) Microarray analysis of shear stressed endothelial cells *Biorheology*, Vol 40, pp 5—11.
8. Susan M. McCormick, Suzanne G. Eskin, Larry V. McIntire, Christina L. Teng, Chiung-Mei Lu, Christopher G. Russell, **Krishnan K. Chittur** DNA Microarray Reveals Changes in Gene Expression of Shear Stressed Human Umbilical Vein Endothelial Cells Proceedings of the National Academy of Sciences, USA, Vol 98, Number 16, pp 8955—8960, July 31, 2001
9. Jing Xie, Clyde Riley and **Krishnan Chittur** (2001) Effect of albumin on brushite transformation to hydroxyapatite *Journal of Biomedical Materials Research*, Vol 57, No. 3, pp -65
10. Mukesh Kumar, Jing Xie, Krishnan K. Chittur, Clyde Riley, (1999) Transformation of Modified Brushite to Hydroxyapatite in Simulated Body Fluid: Effects of Potassium Substitution. *Biomaterials*, *20*, 1389–1399.
11. Haitong Zeng, Krishnan K. Chittur, William R. Lacefield (1999), Dissolution/Reprecipitation of Calcium Phosphate Thin Films Produced by Ion Beam Sputter Deposition Technique, *Biomaterials*, *20*, 443–451.
12. Haitong Zeng, Krishnan K. Chittur, William R. Lacefield (1999), Analysis of bovine serum albumin adsorption on calcium phosphate and titanium surfaces, *Biomaterials*, *20*, 377—384
13. Jeannie D. Haman, Krishnan K. Chittur, Daryl E. Crawmer and Linda C. Lucas (1999) Analytical and Mechanical Testing of High Velocity Oxy-Fuel Thermal Sprayed and Plasma Sprayed Calcium Phosphate Coatings, *J. Biomed. Mater. Res (Appl. Biomater.)*, Vol 48, pp 856–860.
14. Krishnan K. Chittur FTIR and Protein Structure at Interfaces, *Bulletin of the Biomedical Engineering Society*, Volume 23, Number 3, 1999
15. Chittur, K.K. (1998) Surface Techniques to Examine the Biomaterial-Host Interface: An Introduction to the Papers, *Biomaterials*, *19*, 301–305.
16. Chittur, K.K. (1998) FTIR/ATR for Protein Adsorption to Biomaterial Surfaces, *Biomaterials*, *19*, 357–369.
17. Chittur, K.K. (1998) Proteins on Surfaces: Methodologies for Surface Preparation and Engineering Protein Function, In **”Biopolymers at Interfaces“**, Elsevier Surfactant Science Series, Ed. Martin Malmsten, Chapter 6, pp 143–179.
18. Noh, K.K. Chittur, S.L. Goodman, J.A. Hubbell (1997) Surface Modification of Poly(tetrafluoroethylene) with benzophenone and Sodium Hydride by Ultraviolet Radiation. *J. Poly. Sci. A: Polym. Chem. Ed.* *35*, 1499-1514.

19. Nadarajah, A., Lu C.F. and Chittur K.K. (1995) Modeling the dynamics of protein adsorption to surfaces, In: T. Horbett and J. Brash (Editors) "Proteins at Interfaces San Diego 1994", ACS Symposium Series, Chapter 13, pages 181-194.
20. Lu, C.F., Nadarajah, A. and Chittur, K.K. (1994) A Comprehensive Model for Protein Adsorption to Surfaces. J.Coll.Int.Sci., 168, 152-161.
21. J.L. Ong, K.K. Chittur and L.C. Lucas (1994) Dissolution/reprecipitation and protein adsorption studies of calcium phosphate coatings by FT-IR/ATR techniques. J. Biomed. Mater. Res., 28, 1337-1346.
22. Cheng, S.S., Chittur, K.K., Sukenik, C.N., Culp, L.A. and Lewandowska, K. (1994) The conformation of fibronectin on self-assembled monolayers with different surface composition: An FT-IR/ATR study. J.Coll.Int.Sci., 162, 135.
23. Lenk, T.J., Ratner, B.D., Horbett, T.A. and Chittur, K.K. (1991) Infrared spectroscopic studies of time-dependent changes in fibrinogen adsorbed to polyurethanes. Langmuir, 7, 1755.
24. Lenk, T.J., Ratner, B.D., Chittur, K.K., Gendreau, R.M. (1989) IR spectral changes of bovine serum albumin upon surface adsorption. J. Biomed. Mater. Res., 23, 549.
25. Lipkus, A.H., Chittur, K.K., Robinson J.B., Pierce, G. (1990) Evaluation of Infrared Spectroscopy as a Bacterial Identification Method. J. Ind. Microbiol., 6, 71.
26. Lipkus, A.H., Lenk, T.J., Chittur, K.K., Gendreau, R.M. (1988) Cluster Analysis of Protein FTIR Spectra. Biopolymers, 27, 1831.
27. Nyden, M. and Chittur, K.K. (1988) Component Spectrum Reconstruction from Partially Characterized Mixtures, Appl. Spectrosc., 43, 123-128.
28. Nyden, M., Forney, G. and Chittur, K.K. (1988) Spectroscopic Quantitative analysis of Strongly Interacting Systems: Human Plasma Protein Mixtures. Appl. Spectrosc., 42, 588-594.
29. Chittur, K.K., McIntire, L.V., Rich, R.R. (1988) Shear Stress effects on Human T Cell Function. Biotech. Prog., 4, 899-906.
30. Nocentini, M., Gendreau, R.M., Chittur, K.K. (1988) Conformational changes of protein adsorbed on polyurethane studied by FT-IR/ATR spectroscopy. Mikrochim. Acta (Wien) I, 343.
31. Gendreau, R.M., Chittur, K.K., Dluhy, R.A. and Hutson, T.B. (1987) Biological FTIR Spectroscopy: An Overview. International Laboratory, Nov/Dec Issue, 15-21.
32. Tingey, K.G., Andrade J.D., Zdrahala, R.J., Chittur, K.K., Gendreau, R.M. (1988) Surface analysis of polyether and polysiloxane soft segment polyurethanes. In "Surface Characterization of Biomaterials". Ed. B.D. Ratner, Elsevier, Amsterdam, 255.

33. Fink, D.J., Hutson, T.B., Chittur, K.K., Leininger, R.I. and Gendreau, R. M. (1987) Quantitative surface studies of protein adsorption by infrared spectroscopy. II. Quantitation of adsorbed and bulk proteins. *Anal. Biochem.*, **165**, 147.
34. Chittur, K.K., Fink, D.J., Leininger, R.I., Hutson, T.B. (1986). FTIR/ATR studies of protein adsorption in flowing systems. Approaches for bulk correction and compositional analysis in mixtures. *J. Coll. Int. Sci*, **111**, 419.
35. Chittur, K.K., Fink, D.J., Hutson, T.B., Gendreau, R.M., Jakobsen, R.J. and Leininger, R.I., FTIR/ATR Studies of protein adsorption in flowing systems. ACS Symposium Series "Proteins at Interfaces" based on symposium at Anaheim, Sept. 7-12, 1986, **343**, 362377.
36. Chittur, K.K. and Fink, D.J. (1986). Monitoring Biological Processes by Fourier Transform Infrared Spectroscopy. *Enzy. and Microb. Tech.*, **9**, 568572.

Papers In Conference Proceedings

1. K.K. Chittur, "Integration of Aspenplus (and other computer tools) into the Undergraduate Chemical Engineering Curriculum", ASEE Conference, Seattle, July 1998.
2. Vinod K. Mishra, Manjula Chaddha, G.M. Anantharamiah, M.N. Palgunachari, K.K. Chittur, S Lund-Katz, M.C. Phillips and J.P. Segrest, "Synthetic Peptides from Putative Amphipathic β Strand Sequences of Apolipoprotein B-100 Associate with Lipid in the β strand Conformation", Proceedings of the 15th American Peptide Symposium, June 14-19, 1997, Nashville, TN.
3. J.D. Haman, K.K. Chittur, L.C. Lucas: "Properties of HVOF Sprayed Calcium Phosphate Coatings". *Annals of Biomedical Engineering*, **23** (Suppl. 1), S99 (1995)
4. Dasarathy, K.B., Chittur K.K. and Dasarathy B.V. Analysis of Skin Oil by FTIR Spectroscopy. SPIE Proceedings Series, Volume 2847 (Applications of Digital Image Processing XIX), pp 69-77 (1996)
5. Miernik, J.H., Chittur, K.K. and Weimer, J.J. Analysis and Characterization of Mized Alkyl Silane Self-Assembled Monolayers on Metal and Oxide Surfaces. 25th International Conference on Environmental Systems, San Diego, CA, July 10-13, 1995.
6. Dove, M.F.A., Logan, N., Mauger, J.P., Allan, B.D., Greer Jr., C.L., Arndt, R.E., Chittur, K.K. and Hawk, C.W. The Compatibility of 2014 Aluminum Alloy with Gelled IRFNA and Gelled IRFNA containing Phosphoric Oxide (P4O10). 30th AIAA/ASME/SAE/ASEE Joint Propulsion Conference, June 27-29, 1994, Indianapolis, IN
7. Jorgenson, R.C., Yee, S.S., Chittur, K.K. and Burgess, L.W. In-Situ Characterization of Adsorbed Protein Films using Surface Plasmon Resonance. Proceedings of the IEEE Engineering in Medicine and Biology Society 12th International Conference, Nov 1-4, 1990, Philadelphia, PA.

Chapters in Books

1. Agnese Magnani, Gianfranco Peluso, Sabrina Margarucci and Krishnan Chittur, Protein Adsorption and Cellular, Tissues Interaction. Invited Book Chapter for a Book on Integrated Biomaterials Science, Edited by Prof. Rolando Barbucci, University of Siena, Italy.

Technical Reports

1. Discrimination Analysis of Epidermal Lipids Characterized by FT-IR Spectra. November 1993. Final report submitted for the Westinghouse Science Talent Competition by Mr. Keshava Dasarathy, Huntsville High School, working under my direction. Mr. Dasarathy was one of three semi-finalists from Huntsville.
2. Gelled Propulsion Corrosion Experimental Results. December, 1993. Primary Authors: Dr. Norman Logan and Ms. Ramona Arndt (Master's Student), In fulfillment of TRW Contract FG737DC3S.

Selected Seminars and Invited Lectures

1. Novel Technique for DNA detection, School of Chemical Engineering, University of Oklahoma, Norman, Oklahoma, October 11, 2007
2. Gene expression using microarrays and the convergence of chemistry, biology and engineering. The University of Toledo, Toledo, Ohio, February 28, 2003
3. Gene Expression using Microarrays: Understanding shear stressed endothelial cells: University of Arizona, Tucson, AZ June 17, 2002
4. Microarrays and endothelial cells, Arizona State University (Biomedical Engineering Department), Phoenix, AZ, February 17, 2002
5. Understanding gene expression in endothelial cells using microarrays: University of Virginia (Biomedical Engineering), Charlottesville, VA, March 28, 2002
6. Gene expression in endothelial cells using microarrays: Virginia Commonwealth University (Chemical Engineering Department), Richmond, VA, March 29, 2002
7. The Human Genome Project: Academy of Life Long Learning, University of Alabama in Huntsville, October 31, 2001
8. Study of Biological/Biomaterial Interfaces through FTIR/ATR Techniques, Department of Bioengineering, University of Toledo, July 1998.
9. Biological/Biomaterial Interfaces and Chemical Engineering, Department of Mechanical Engineering and the Cardiovascular Engineering Center, Florida International University, Miami, Florida, July 1998.
10. Study of Biological/Biomaterial Interfaces through FTIR/ATR Techniques, Biomedical Engineering Institute, Pennsylvania State University College of Medicine, Hershey, PA, August 1998.

11. Analysis of Protein Conformation and Orientation in Lipid Bilayers through FTIR/ATR Techniques, Atherosclerosis Research Unit, Department of Medicine, University of Alabama in Birmingham, April 30, 1997.
12. European School in Biomaterials, Siena, Italy, April 15-21, 1996.
13. Protein Adsorption using FT-IR/ATR, Biomedical Engineering Department, University of Alabama in Birmingham. November 1, 1994.
14. Protein Adsorption (Cells and Materials), Scanning Microscopy Meeting, Toronto, May 7-12, 1994.
15. The 4th European Symposium on Biomaterials, April 8-13, 1991 Siena, Italy. Invited Speaker.
16. Protein adsorption with FT-IR/ATR, Department of Biomedical Engineering, University of Alabama in Birmingham, Fall 1992.
17. The blood-material interface: Studies with FT-IR/ATR spectroscopy. Biomedical Engineering Department, Rensselaer Polytechnic Institute, Troy, NY, Jan 1990.
18. Protein Adsorption to Biomaterials, Center for Biochemical Engineering, Duke University, August 3, 1989.
19. Protein Adsorption to Biomaterials, Department of Pharmacy, Purdue University, January 31, 1989.

Selected Abstracts and Presentations-Since 1987

1. Microarrays for understanding the effect of shear stress on endothelial cells, Annual Meeting of the American Institute of Chemical Engineers, November 9, 2001, Reno, Nevada.
2. DNA Microarrays for studying shear stressed endothelial cells, Annual Meeting of the Biomedical Engineering Society, Seattle, Washington, October 2000,
3. American Institute of Chemical Engineers, November 2000, Session Chair for Two sessions, Dallas, Texas.
4. Preparation and characterization of PEG Coatings on Titanium:, Annual Meeting of the American Institute of Chemical Engineers, October, 1999, Dallas, Texas.
5. Chair of Workshop on Probing and Imaging Cells and Molecules, Annual Meeting of the Society for Biomaterials, Rhode Island, May 1999.
6. Preparation and characterization of brushite on titanium: The effect of potassium, Annual Meeting of the American Institute of Chemical Engineers, November 16-20, 1998, Miami, Florida.
7. Orientation of Human Apolipoprotein A-I amphipathic helices in discoidal lipoproteins: A reinvestigation using polarized attenuated total internal reflection fourier transform infrared (PATIR-FTIR) spectroscopy (1998 S.E. Lipid Conference, Lake Lanier Islands, GA, September 1998) (authored with Vinod K. Mishra and J.P. Segrest)
8. Conformational changes in bovine serum albumin (BSA) and its effect on transformations of brushite to hydroxyapatite: In-Situ studies using FTIR/ATR -1997 Fall Meeting, Materials Research Society, December 1-5, 1997 (coauthored with Jing Xie and Clyde Riley)
9. Electrodeposition of brushite and transformation to hydroxyapatite: In-Situ studies using FTIR/ATR - Correlation with X-Ray Diffraction and SEM/EDS - 1997 Fall Meeting, Materials Research Society, December 1-5, 1997 (coauthored with Mukesh Kumar and Clyde Riley)
10. Evaluation of Ceramic and Metallic Biomaterial Surfaces, 1997 Annual Meeting of American Institute of Chemical Engineers, Los Angeles, CA (co-authored with Haitong Zheng and William Lacefield)
11. LDL Receptor Binding Domain of Apolipoprotein B-100: Conservation of Sequence and Structure in Nine Vertebrate Species, 70th Scientific Sessions of the American Heart Association, November 9-12, 1997, Orlando, FL (co-authored with Jere Segrest, Martin K. Jones, Vinod Mishra, Vincezo Pierotti, Stephen Young, Jan Boren, Thomas Innerarity, Nassrin Dashti)
12. Synthetic Peptides from Putative Amphipathic β Strand Sequences of Apolipoprotein B-100 Associate with Lipid in the β strand Conformation, Poster at the 15th American Peptide Symposium, June 14-19, 1997, Nashville, TN.

13. Protein Adsorption to Surfaces - Do Multilayers Exist? J. Lu, Arun Nadarajah and Krishnan Chittur, 23rd Annual Meeting of the Society for Biomaterials, April 30-May 4, 1997, Abstract Published in the Transactions of the Society for Biomaterials, page 89, (Co-authored with J. Lu and Arunan Nadarajah)
14. Dissolution Kinetics of Brushite: Correlation of FTIR/ATR with XRD, 23rd Annual Meeting of the Society for Biomaterials, April 30-May 4, 1997, Abstract Published in the Transactions of the Society for Biomaterials, page 388(Co-authored with Mukesh Kumar and Clyde Riley)
15. Modeling Protein Adsorption to Surfaces, Annual Meeting of the American Institute of Chemical Engineers, Chicago, IL November 1996Co-authored with J. Lu and Arunan Nadarajah)
16. Analysis of Skin Oil by FTIR Spectroscopy. International Symposium on Optical Science, Engineering and Instrumentation: SPIE Annual Meeting, August 4-9, 1996, Denver, Colorado.
17. Crystallinity and phase content determination of Hydroxyapatite coatings. 21st Annual Meeting of the Society for Biomaterials, San Francisco, March 1995.
18. J. D. Haman, K. Chittur, L. C. Lucas, and D. E. Crawmer, "FTIR Analysis of High Velocity OxyFuel Thermal Sprayed Hydroxyapatite Coatings", 8th Annual Materials Research Conference, Tuscaloosa, Alabama, September, 1994.
19. J.D. Haman, K.K. Chittur, L.C. Lucas, D.E. Crawmer, "Crystallinity and Phase Content Determination of HA Coatings". Society For Biomaterials 21st Annual Meeting, San Fransisco, California, March, 1995.
20. J.D. Haman, K.K. Chittur, L.C. Lucas, "Properties of HVOF Sprayed Calcium Phosphate Coatings". 9th Annual Materials Research Conference, Birmingham, Alabama, September, 1995.
21. J.D. Haman, K.K. Chittur, L.C. Lucas: "Properties of HVOF Sprayed Calcium Phosphate Coatings". Biomedical Engineering Society Fall Meeting, Boston, Massachusetts, October, 1995.
22. A Comprehensive model of multi-protein adsorption on surfaces, American Institute of Chemical Engineers, 1994 Annual Meeting, November 13-18, San Francisco, CA.
23. Protein adsorption and dissolution behavior of calcium phosphate coatings. H. Zheng, W. Lacefield and Chittur, K.K. Coauthors from UAB. 8th Annual Alabama Materials Research Conference, September 26-27, 1994, Tuscaloosa, AL.
24. Conformation of Albumin and Fibronectin on Sputter deposited Ca-P coatings. Ong, J., Lucas, L.C., Chittur, K.K. Coauthors from UAB. Paper presented at Society for Biomaterials Annual Meeting in Boston, MA April 5-April 9, 1994.
25. Comprehensive model of protein adsorption on Biomaterial Surfaces. Lu, C.F., Nadarajah, A., and Chittur, K.K. Coauthors from UAH. Paper presented at Society for Biomaterials Annual Meeting in Boston, MA April 5-April 9, 1994.

26. Session Co-Chairman, Podium Session # 44, "Surface Modification II", at the Society for Biomaterials Annual Meeting in Boston, MA April 5-April 9, 1994.
27. Organized a session on *Spectroscopic Methods for Studying Protein Adsorption* at the Fall 1993 Meeting of the Biomedical Engineering Society, Memphis, TN, October 21-24, 1993. Two papers presented at this session.
28. Extrinsic Labels for Protein Adsorption. Chittur, K.K., Orr, S.A. and Harris, J.M. Coauthors from UAH.
29. Effect of crystallinity of Calcium Phosphate Coatings on Dissolution in Saline, Protein. FT-IR/ATR Study. Ong, J., Lucas, L.C. and Chittur, K.K. Coauthors from UAB.
30. Gordon Conference on Biomaterials and Biocompatibility, Holderness School, New Hampshire, July 1993. Two posters were presented.
31. Comprehensive Model of Protein Adsorption, Lu, C.F, Nadarajah and Chittur, K.K.
32. An Infrared Label for Proteins, Chittur, K.K., Harris, J.M, Orr, S.A.
33. The conformation of fibronectin on self-assembled monolayers with different surface composition: An FT-IR/ATR study. 19th Annual Meeting of the Society for Biomaterials, April 28-May 2, 1993, Birmingham, AL.
34. Extrinsic infrared labels for protein adsorption studies with FT-IR/ATR. 19th Annual Meeting of the Society for Biomaterials, April 28-May 2, 1993, Birmingham, AL.
35. FT-IR/ATR studies of fibrinogen adsorption onto radiofrequency plasma polymerized films (poster), 19th Annual Meeting of the Society for Biomaterials, April 28-May 2, 1993, Birmingham, AL.
36. Protein-surface interactions: Studies through application of FT-IR/ATR techniques to biomaterial surfaces. Annual AIChE Meeting, November 5-11, 1989, San Francisco.
37. Langmuir-Blodgett monolayers as a model system for studying protein-polymer interactions. 15th Annual Meeting of the Society for Biomaterials, April 28-May 2, 1989, Lake Buena Vista, Florida.
38. Protein Adsorption: Cluster analysis of FT-IR Spectra: Division of Polymeric and Materials Science, ACS Annual Meeting, September 1988, Los Angeles, California.
39. Mechanisms of Protein Adsorption to Polymer Surfaces: Society of Biomaterials, Annual Meeting, Kyoto, Japan, April 1988.
40. FTIR Studies of Protein Adsorption: 8 Years later. Poster presentation, 6th International Conference on Fourier Transform Spectroscopy, Vienna, Austria, August 25-29, 1987.
41. Expert Systems for Biomedical FTIR Poster presentation, 6th International Conference on Fourier Transform Spectroscopy, Vienna, Austria, August 25-29, 1987.

42. Studies of Plasma Protein Adsorption Kinetics onto Polymers. 19th Regional ACS Meeting, Columbus, Ohio, June 2325, 1987.
43. Protein Adsorption Studies: Cluster Analysis of FTIR Spectra. 19th Regional ACS Meeting, Columbus, Ohio, June 2325, 1987.
44. Bacterial Identification by FTIR. Society for Industrial Microbiology, Baltimore, MD, August 1014, 1987.
45. Quantitative and Quantitative Monitoring of Surfactant and Pigment production in *Serratia Marcescens* by FTIR. (Poster) Society for Industrial Microbiology, Baltimore, MD, August 1014, 1987.
46. Studies of Plasma Proteins and Polymers by FTIR/ATR Techniques. 61st Colloid and Surface Science Symposium, Ann Arbor Michigan, June 2124, 1987.
47. The Quantitative analysis of plasma protein mixtures by FTIR spectroscopy. Pittsburgh conference, Atlantic City, NJ, March 1012, 1987.

Current Student Supervision

1. Mr. Jonas Boateng (PhD Student, Biotechnology Science and Engineering Program. Dissertation project on Nucleic Acid binding and detection
2. Jeffrey J. Dowell (PhD Student, Biotechnology Science and Engineering Program) A Novel Nucleic Acid detection approach

Dissertations/Theses Completed

1. Ms. Mayson Alkhatib, Ph.D., Biotechnology Science and Engineering, Degradable Polymers for drug delivery (Fall 2006)
2. Mr. Sameer Vasantgadkar, M.S., Chemical Engineering: A novel technique for detecting DNA in mixtures (Fall 2006) Ms. Meghan Jekel, M.S., Chemical Engineering, A novel method for ion-exchange (Spring 2006)
3. Mr. Fei Zhuang, M.S. Chemical Engineering Deltamethrin treatment of bednets by in situ polymerization of HEMA/PEGA, Fall 2005. (Co Advisor: Dr. Douglas G. Hayes, University of Tennessee, Knoxville)
4. Ms. Haritha Katta, M.S. Chemical Engineering: Differentiating the effects of collagen from rotation in the NASA Bioreactor (Spring 2003)
5. Ms. Alka Potdar, M.S., Chemical Engineering:, Effect of Simvastatin on osteoblast mineralization using FTIR (Summer, 2003)
6. Mr. V. Balasubramian, M.S., Chemical Engineering, Fall 2001 Developing large scale techniques for the purification of an engineered protease, Summer, 2002 (Co advisor: Dr. Douglas G. Hayes, Chemical Engineering)

7. Mr. Anshuman Bansal, M.S. Chemical Engineering Developing large scale techniques for the purification of an engineered protease, Summer, 2002 (Co advisor: Dr. Douglas G. Hayes, Chemical Engineering)
8. Mr. Geoffrey Jiang, Materials Science Ph.D. Program, UAH, Spring 2001 Thesis: In Situ Study of Brushite Deposition (Primary Advisor: Dr. Clyde Riley)
9. Mr. Pankaj Bavishi, M.S. Chemical Engineering, Summer 2000 Thesis: Enhancing the coverage and stability of PEG coatings on titanium (Chairman)
10. Ms. Yantong Liu, M.S., Chemical Engineering, Spring 2000 Thesis: Experimental Studies of Blood Protein Adsorption using Extrinsic Infrared Labels (Chairman)
11. Ms. Penny Xia, M.S. Chemistry, Spring 2000, Thesis: Infrared Signatures of Mammalian Cells in Culture (Chairman)
12. Mr. Lee Nickel, M.S., Chemical Engineering, Fall 1999 Thesis: Shear stability of poly(ethylene glycol) coatings on titanium (Chairman, Co Advised by Dr. Jeffrey Weimer, Chemistry/Chemical Engineering)
13. Ms. Lisa Crawford, M.S., Chemical Engineering, March 1999.
14. Mr. Joel Adair, M.S., Chemical Engineering, November 1998.
15. Ms. J. Lu, M.S., Chemistry, March 1997. Thesis: Experimental Investigation and Theoretical Analysis of Blood Protein Adsorption on Hydrophobic and Hydrophilic Surfaces (Chairman, Co Advised by Dr. Arunan Nadarajah)
16. Ph.D., Dr. Haitong Zheng, Biomaterials Department, University of Alabama in Birmingham (Primary Advisor: Dr. William Lacefield, UAB) Dissolution/reprecipitation and protein adsorption properties of bioceramic (1997).
17. Mr. Jamil Naser, M.S., Chemical Engineering, March 1996. Plan II Report: FTIR/ATR Studies of Protein Adsorption Using Extrinsic Infrared Labels". (Chairman)
18. Ms. Ramona Arndt, M.S., Chemical Engineering, September 1995. Thesis: Study of gelled propellant corrosion processes using electrochemistry, surface analytical techniques. (Chairman)
19. Ms. Chun Fang Lu, M.S., Chemical Engineering, June 1994. Thesis: Theoretical and Experimental Investigation of Protein Adsorption on Surfaces (Chairman, Co Advised by Dr. Arunan Nadarajah))
20. Mr. Mukesh Kumar, Materials Science Ph.D. program, UAH, Spring 1999. Thesis: Mechanisms of Electrochemical Brushite Deposition using FTIR/ATR (Primary Advisor: Dr. Clyde Riley, UAH, I was the Co-Advisor)
21. Ms. Jing Xie, Materials Science Ph.D. program, UAH, Spring 2000. Thesis: Protein adsorption onto electrochemically deposited bioceramic coatings (Primary Advisor: Dr. Clyde Riley, UAH, I was the Co-Advisor)

22. Ms. Jeannie Haman, Ph.D. Biomedical Engineering, University of Alabama in Birmingham (Primary Advisor: Dr. Linda C. Lucas, UAB, I Was the Co-Advisor) Effect of processing conditions on physical and chemical properties of bioceramic coatings for implant applications
23. Mr. J.L. Ong. Ph.D. Biomedical Engineering, University of Alabama in Birmingham, 1994 (Advisor: Dr. Linda C. Lucas, UAB, I was the Co Advisor) Dissolution/reprecipitation and protein adsorption properties of bioceramics (1995)
24. Mr. Xiang Wang, M.S. Biomedical Engineering Department, Case Western Reserve University, Cleveland, Ohio. January 1993. Coadvised by Dr. Roger Marchant (CWRU) and myself, supported by my NIH Grant. “*In Situ* Adsorption of Fibrinogen on Plasma Polymerized Thin Films Studied by Infrared Spectroscopy”
25. Thomas J. Lenk, Ph.D., Chemical Engineering Department, University of Washington, Seattle, WA. (January 1990) Primary advisor: Dr. Buddy Ratner. I was Mr. Lenk’s primary advisor at Battelle’s FT-IR center. “Infrared Studies of Protein Adsorption and Transitions on Polyurethanes”
26. Mr. Kevin Tingey, Ph.D., Biomedical Engineering Department, University of Utah, Salt Lake City, Utah. (1992) Primary advisor: Dr. Joseph Andrade. I was Mr. Tingey’s primary advisor at Battelle’s FT-IR center. Kevin investigated the properties of polyurethanes in an aqueous environment.

Other Theses Committees (as a member)

1. Ph.D., Mr. Lynn Deibler, Department of Physics, UAH.
2. Ph.D., Dr. Xuan Zhao, Materials Science Ph.D. program, UAH. Biodegradable hydrogels for delivering proteins (1997) (Advisor: J. Milton Harris, UAH)
3. Ph.D., Dr. Mike Roberts, Materials Science Ph.D. program, UAH. Pegylation of Proteins (1997) (Advisor: J. Milton Harris, UAH)
4. Ph.D., Dr. Sourabh Mishra, Materials Science Ph.D. Program, UAH.

Collaborators

1. Dr. Kannan Moudgalya, Professor/Chemical Engineering, Indian Institute of Technology, Bombay, India - ASCEND, software for teaching engineers
2. Dr. Bob Zahorchak, Hudson Alpha Institute for Biotechnology - DNA detection and methodologies
3. Dr. Joel Peek, Microarrays, Inc. (housed within Hudson Alpha Institute for Biotechnology). Novel microarrays and nucleic acid detection
4. Dr. Milton Harris, Distinguished Professor (Retired) Chemistry Department, University of Alabama in Huntsville. Extrinsic IR labels, protein chemistry, non-fouling surfaces, PEG gels for drug delivery.

5. Dr. Clyde Riley, Chemistry Department, UAH - Brushite as a biocompatible coating for biomaterial applications.
6. Dr. Linda Lucas, Department of Biomedical Engineering, UAB, Birmingham, AL. Characterization of protein adsorption and dissolution rates of hydroxyapatite Coatings under aqueous conditions using FT-IR/ATR.
7. Drs. Jere Segrest and Vinod Mishra, Atherosclerosis Research Unit, University of Alabama in Birmingham. Orientation of apolipoproteins in lipid bilayers by polarized ATR techniques. Polarized FT-IR/ATR techniques are being used to understand the structure and orientation of apolipoproteins in a lipid complex.
8. Dr. Charlie Prince, Nutrition Sciences, University of Alabama in Birmingham. Infrared Signatures for Mammalian Cells in Culture (Co-I on my NASA Grant)
9. Dr. Joseph Ng (UAH, Biological Sciences), Dr. Marc L. Pusey (NASA, Marshall Space Flight Center) – Universal approaches to detecting nucleic acids in complex solutions, site specific RNA Labeling

Courses taught

1. ChE 197: Computer Methods for Chemical Engineering
2. ChE 244: Stoichiometry
3. ChE/ME 294: Nature and Properties of Materials
4. ChE 344: Chemical Engineering Thermodynamics
5. ChE 440: Unit Operations Laboratory
6. ChE 443: Mass Transfer Operations
7. ChE 447: Chemical Engineering Design I (StageWise Operations)
8. ChE 448: Chemical Engineering Design II (Capstone Design) (includes Introduction to and use of Simulation programs such as AspenPlus, ChemCAD, ASCEND)
9. ChE 460/560 Introduction to Bioprocess Engineering
10. ChE 461/561 Bioseparations
11. ChE 649: Transport Phenomena
12. ChE 747: Advanced Topics in Bioengineering
13. ChE 599: Special Topics (Experimental Methods in Electrochemistry)
14. ChE 659 Special Topics (Fermentation Techniques for the Production of an Engineered Protease)
15. BSE 620 Introduction to Bioinformatics: Fundamentals and Methodologies

16. BSE 621 Introduction to Bioinformatics: Computing Laboratory for Applications

New Courses Developed

1. ChE 460/560, ChE 461/561 – Sequence of two courses in Biotechnology for chemical engineering undergraduates and graduate students in the Biotechnology PhD Program
2. BSE 620 Introduction to Bioinformatics: Fundamentals and Methodologies
3. BSE 621 Introduction to Bioinformatics: Computing Laboratory for Applications

Undergraduate Research Supervised

1. Judith Pelger (1993/94), Shawn Harmon (1993/94) FTIR and Protein Adsorption
2. Keshava Dasarathy (Huntsville High School, 1993) - Analysis of Skin Oils with FTIR
3. Al Zwiener (1996), Craig Morgan (1996) Design and Assembly of Device to Measure Protein Crystal Growth, Dena Routon (1995/6) Protein purification and characterization
4. Walter Campbell (1997), Characterizing Atomic Force Microscopy Tip Shape by Image Analysis
5. Ola Janik (from the Alabama School of Math and Sciences) (Summer 1998) Testing of PEG Gels, Analysis of PEG using FTIR Techniques

Undergraduate Honors Project

- Vivian Nguyen - DNA detection, antibiotic sensitivity (2012/2013)
- Lisa Jones - Ethanol Production from Municipal Solid Waste, 1995.

Other activities

1. Review submitted manuscripts to Journal of Colloid and Interface Science, Biomaterials, Langmuir, Surface and Interfacial Analysis, Journal of Biomedical Materials Research, Journal of Biomaterials Science.
2. **Guest Editor** for Special Issue of *Biomaterials* “Surface Techniques to Examine the Biomaterial-Host Interface”. Issue appeared in 1998.
3. Organizer of Academic Workshop titled “Probing and Imaging of Cells and Molecules” at the 1999 Annual Meeting of the Society for Biomaterials.
4. **Review panel member** for the National Science Foundation (XYZ on a Chip, March, 1999) National Institute’s of Health (Division of Research Resources, Special Emphasis Panel, October 1998, February 1999).
5. Taught short courses in Biomedical Infrared Spectroscopy.
6. A short course on ESCA and FT-IR for the study of biomaterials. World Congress on Biomaterials, Society for Biomaterials, Kyoto, Japan, April 1988.
7. Biomedical FT-IR: Short course. 5th International Symposium on New Spectroscopic Methods for Biomedical Research, University of Washington, Seattle, October 1986.

Summary of Research Interests

For a number of years, I worked on Fourier Transform Infrared (FTIR) with Attenuated Total Internal Reflection (ATR) methods to understand protein adsorption to biomaterial surfaces. These studies were driven in part by the realization that the design of biocompatible biomaterial requires a detailed understanding of protein adsorption to biomaterial surfaces. FTIR/ATR methods have proven to be an excellent method with which we can study how surface chemistry affects protein amounts and structure. I have had several successful collaborations with groups at UAHuntsville and UAB particularly in the areas of bioceramic coatings for implants. We have published extensively in this area in leading biomaterials journals. In recognition of my efforts in FTIR/ATR, I was asked to seek and edit a special issue of the journal Biomaterials dealing with several methods investigators use in understanding protein adsorption to surfaces. My expertise in FTIR/ATR led me to assist a group at the Atherosclerosis Research Unit at UAB understand the properties of apolipoprotein A1 and a series of peptide analogues in the lipid environment. Using FTIR/ATR we investigated the secondary structure of the protein (peptide) and their orientation relative to the lipid bilayer. Our work in developing infrared signatures for mammalian cells in culture, grew out of such FTIR/ATR expertise.

My sabbatical at Research Genetics (1999/2000) resulted in a shift in my interests to microarrays for gene expression. The work I began at Research Genetics led to a collaborative project with groups at Rice University and the University of Illinois to study endothelial cells under shear stress. Our results, published in the Proceedings of the National Academy of Sciences (USA) identified a number of genes that may be very important in the formation of plaques in the human vasculature. I am pleased to notice that this paper has been very well cited and continues to be used by many as they understand shear stressed endothelial cells. The experience at Research Genetics led me to invent a new method for detecting nucleic acids in complex mixtures. (US Patent 7,291,459). This remains the focus of my current research efforts. I took a sabbatical at the HudsonAlpha Institute for Biotechnology in 2007/2008 and that resulted in our winning 1st Prize at the Alabama Launchpad Competition (April 16, 2010). In addition to working on developing rapid and easier methods for pathogen detection, it is my hope that it will lead to novel microarrays that will not require the labeling of the target messenger RNA's for gene expression studies and a rapid method for pathogen diagnostics.

Summary of Teaching Interests

I have taught most of the required classes for the chemical engineering major, and find the teaching of Capstone Design to be the most challenging and eminently rewarding. It requires that students understand how to synthesize information learned during their entire undergraduate curriculum and then some. I have also enjoyed teaching the introductory programming class (freshmen) and thermodynamics. As I watched the technology evolve, I applied for (and got) minigrants from the Provost's Office to develop courseware for many of our classes and design a ToolBox CD for our students. The ToolBox CD project was designed to provide students with useful software and courseware – many downloaded from different web sites or duplicated with permission from original sources. For many years, we distributed the CD's (at cost) to any student who wanted it, today we collect such tools on our departmental website. I am pleased to say that we have learned from watching many others share their courseware and now have a very extensive set of notes and other useful material for our students on our website. Much of the initial design of the website and a lot of the routine maintenance was done by myself with help from Jeffrey Weimer and Douglas Hayes (now at Univ. of Tennessee).

My frustration with commercial, expensive, closed form software for process simulation led me a project titled ASCEND, which is a free, open source software program for solving small to very large mathematical models. The project was started by Prof. Art Westerberg of Carnegie Mellon University (now retired) and includes a dedicated group of users, software developers who collaborate using a **wiki** <http://ascend4.org>. This project was picked for student support by *Google Summer of Code 2009, 2010, 2011 and 2012*. We received support for 5 students each year from many parts of the world, including from IIT Bombay, in Mumbai, India. We anticipate that Google's support will help us improve the package in many ways, including simplification of the syntax and adding real-time calculation possibilities.

I am very interested in Bioinformatics and am exploring ideas to implement advanced undergraduate courses and a new, interdisciplinary graduate program. At the undergraduate level, I have been working on discovering ways to improve how we educate ALL of our students for the rapidly changing world.

Summary of Service to Profession

1. Invited to organize academic workshop at the 1999 Society for Biomaterials Meeting.
2. Serve on Special Emphasis Panel at the NIH - Study Section for R21 Grant Applications, October 1998, February 1999.
3. Served on XYZ on a Chip Panel at the NSF, February 1999.
4. Edited a special volume on Biomaterials, an international journal.
5. Review papers for a number of journals (as a peer-reviewer).
6. Active participant in the Proteins and Cells Special Interest Group of the Society for Biomaterials.
7. Organized a special session on spectroscopic method for studying protein adsorption at Biomedical Engineering Society's Fall 1993 meeting.
8. Session Co-Chair for "Surface Modification II" session at the Society for Biomaterials annual meeting in Boston, April 1994.
9. Invited to participate at the 4th European Symposium on Biomaterials, held in Siena, Italy, April 8-13, 1991.
10. Reviewed grant proposal submitted to the State of Connecticut for the purchase of an FT-IR system.
11. Reviewed grant proposals from the National Science Foundation.
12. Reviewer for papers submitted to the Journal of Biomaterials Science, Journal of Biomedical Materials Research.
13. Provide advanced infrared analytical capabilities to biomaterials researchers at UAH, UAB and other colleagues.