

DR. STEVEN GARDNER

Professor of Chemical Engineering
The University of Idaho
875 Perimeter Drive
Moscow, ID 83844-0904
904.463.1658
gardner@uidaho.edu

SUMMARY OF QUALIFICATIONS AND EXPERIENCE

Tenured university professor of chemical engineering for ten years and principal chemical engineer in industry for twenty years. Internationally recognized expertise in developing and synthesizing new materials for catalytic chemical conversion, membrane separation and structural composites.

UNIVERSITY RESEARCH AND TEACHING: Chemical kinetics, catalysis, thermodynamics, transport phenomena, heat/mass transfer, applied statistics, reactor design.

UNIVERSITY SPONSORED RESEARCH: Recipient of \$415,000 in grants from NSF, EPA and ARPA, among others.

MATERIALS SCIENCE: Expertise in adhesion, micromechanics and interfacial phenomena involving polymers and composites. Published the first atomic analysis of carbon fiber cross-sections.

HETEROGENEOUS CATALYSIS: Subject matter expert in catalyst design, synthesis and characterization. Discovered some of the most active room-temperature oxidation catalysts to date.

SPECTROSCOPY AND CHEMICAL ANALYSIS: HPLC, GC, SEM, IR, Raman, XPS, ISS, Auger.

INDUSTRIAL CHEMICAL PROCESS ENGINEERING: Proficient, creative and reliable in identifying and resolving process deficiencies. Strong record of continuous improvement, risk analysis and process/product design.

SIX-SIGMA: Black-Belt certification with proven application and success within a manufacturing environment. Proficient with Minitab software.

COMPUTER MODELING/SIMULATION: Matlab, MathCad, ChemCad, Aspen, VBA, MS Office.

COMMUNICATION/DISSEMINATION: Forty publications in peer-reviewed scientific journals; over forty presentations at national/international conferences including several invited seminars. Principal author of thirty invention disclosures, trade secrets and patents.

PROFESSIONAL EMPLOYMENT

**Professor of Chemical Engineering (*tenured*), August 2024-present
University of Idaho**

Lou Edwards endowed professor of chemical engineering. Establishing the States first surface science laboratory featuring x-ray photoelectron spectroscopy (XPS), among other techniques, with emphasis on design and characterization of solid catalysts, composite materials and polymer membranes.

**Senior Principal R&D Engineer, Pall Corporation (Membrane Technology Center), 2011 - 2024
Pensacola, Florida**

Directed projects to develop fluoropolymer membranes for liquid and gas purification. Subject matter expert with respect to membrane design, synthesis, surface modification and characterization.

Author of thirty invention disclosures, patents and trade secrets.

Recipient of the Pall President's Award for Global Innovator of the Year, 2022.

Guided efforts in continuous improvement activities, risk analysis (FMEA), root-cause analysis (RCA) and process optimization (DoE) to reduce process variability and increase yields.

Liaison with Pall Aerospace (Tampa) in the development of catalysts for aircraft cabin air purification.

**Senior Process Engineer, LyondellBasell, 2002-2010
Jacksonville, Florida and Brunswick, Georgia**

Chemical process engineering and R&D: Provided technical support for the manufacture of flavor and fragrance (F&F) molecules for use in consumer products such as detergents, vitamins, colognes, cosmetics and beverages. Achieved step-change improvements in process design and functionality.

Six-Sigma: As a Six-Sigma black belt, successfully advocated the use of Six-Sigma and mentored site personnel regarding Six-Sigma fundamentals and statistical tools. Participated in the training of over 30 Six-Sigma green belts. Chosen as the first engineer at both production sites to organize and implement team-building activities to foster plant-wide commitment to continuous process improvement.

Chemical reaction engineering: Directed a team whose activities increased reactor yield and selectivity valued near \$700,000 in annual raw materials savings. Also achieved best-in-class reactor operability/stability via modifications to fluid flow, reactor design, emulsion logistics and coke mitigation.

Hydroperoxide synthesis: Managed a Six-Sigma initiative that achieved best-in-class reactor stability by eliminating instances of oxygen starvation thereby improving product quality equivalent to \$300,000 in annual feed savings.

Computer modeling: Developed a computer algorithm to determine optimum reaction conversions to maximize net production of compounds strategic to business objectives.

Sulfur chemistry and catalysis: Performed R&D that identified sulfur compounds problematic to catalyst performance in batch hydrogenation reactions. Implemented successful mitigation program saving \$300,000 in annual catalyst usage.

ASPEN IP.21: Programmed extremely powerful Excel spreadsheets to archive process data to an IP.21 historian forming the basis for process monitoring and continuous improvement activity.

**Process Engineer, International Flavors and Fragrances, 1999-2002
Jacksonville, Florida**

Chemical process engineering: Provided technical support for the production of consumer flavor and fragrance molecules and intermediates. Created innovative reactor design modifications (for example,

in-situ methods to tune radiant heat transfer) that improved product yields tantamount to \$350,000 in annual feed savings.

Chemical surface passivation: Directed an experimental program that successfully mitigated fouling of structured packing in critical distillation operations through the use of anti-oxidants and metal chelators.

Catalysis: Designed, synthesized and evaluated catalysts for the hydrogenation and oxidation of terpene hydrocarbons. Managed a R&D program to screen the catalytic activity of hydrogen-storage alloys and noble metals supported on various transition metal oxides.

Adjunct Professor of Engineering, 1999-2000
Jacksonville University, Jacksonville, Florida

Undergraduate teaching: Instructor for the undergraduate thermodynamics course in the engineering curriculum. *All compensation was donated to Florida higher education.*

Associate Professor of Chemical Engineering (tenured), 1995-1998
Mississippi State University

Sponsored research: Relentlessly competed in the process of proposal submission and articulation of new ideas which resulted in \$415,000 in grants from the NSF, EPA and ARPA, among others. Excelled as a principal investigator of research in surface and interfacial chemistry.

Undergraduate/graduate teaching, advising, mentoring and thesis direction: Consistently received outstanding faculty and student evaluations. Created four new courses in the Department's curriculum.

Founder and Director of the Department's Center for Surface and Chemical Analysis: Responsible for the funding and application of ultra-high vacuum spectroscopy instrumentation. The laboratory's capabilities can be matched by only a few facilities in the country.

Assistant Professor of Chemical Engineering, 1991-1995
Mississippi State University

Materials research: Developed an internationally recognized micromechanical model to predict the properties of composite materials based on the properties of the individual constituents including functionalized carbon fibers, customized interphases, dispersants, and bulk matrices.

Infrastructure improvements: Awarded a research grant from NSF to establish a surface science laboratory with state-of-the-art capabilities featuring XPS, AES and ISS.

Catalyst research: Ongoing development of low-temperature CO oxidation catalysts comprised of gold and/or platinum nanoparticles on various reducible metal oxides.

EDUCATION

University of Florida, Ph.D. awarded December 1990 in Chemical Engineering.
Dissertation Title: High Performance CO Oxidation Catalysts Engineered for CO₂ Lasers.

University of Alabama-Huntsville, M.S.E. awarded June 1987 in Chemical Engineering.
Thesis Title: A Temperature-Programmed Desorption Study of Iron-Titanium Alloy and Iron Supported on Titania.

University of Alabama-Huntsville, B.S.E. awarded June 1985 in Chemical Engineering.

CONFERENCES/PRESENTATIONS

S. D. Gardner and G. B. Hoflund, "Surface Characterization Study of the Reduction of Air-Exposed Pt/SnO₂ and Pt₃Sn Surfaces," presented at the Third Workshop for the Development of CO Oxidation Catalysts for TEA Laser Applications, University of Florida, Gainesville, Florida, May, 1988.

S. D. Gardner, G. B. Hoflund, D. R. Schryer and B. T. Upchurch, "Platinized Tin Oxide Catalysts for CO₂ Lasers: Effects of Pretreatment," presented at SPIE's Symposium on Innovative Science and Technology, Los Angeles, January, 1989.

S. D. Gardner and G. B. Hoflund, "MnO_x-Based Catalysts for CO₂ Laser Applications," presented at the Fourth Workshop for the Development of CO Oxidation Catalysts for TEA Laser Applications, NASA Langley Research Center, Hampton, Virginia, May, 1989.

G. B. Hoflund, S. D. Gardner, M. R. Davidson and O. Melendez, "Preparation, Characterization and Catalytic Behavior of Low-Temperature CO Oxidation Catalysts," presented at the Fourth Workshop for the Development of CO Oxidation Catalysts for TEA Laser Applications, NASA Langley Research Center, Hampton, Virginia, May, 1989.

S. D. Gardner, G. B. Hoflund, D. R. Schryer, B. T. Upchurch, D. R. Brown and J. Schryer, "Alternative Catalysts for Low-Temperature CO Oxidation," presented at the International Conference on CO Oxidation Catalysts for Long-Life CO₂ Lasers, NASA Langley Research Center, Hampton, Virginia, October, 1989.

G. B. Hoflund, J. E. Drawdy, S. D. Gardner, M. R. Davidson, D. R. Schryer and B. T. Upchurch, "Characterization Studies of a Commercial Pt/SnO₂ Catalyst," presented at the International Conference on CO Oxidation Catalysts for Long-Life CO₂ Lasers, NASA Langley Research Center, Hampton, Virginia, October, 1989.

G. B. Hoflund, J. E. Drawdy, S. D. Gardner and D. R. Schryer, "The Development of Low-Temperature CO Oxidation Catalysts for Use in CO₂ Lasers," presented at the European Conference on Applications of Surface and Interface Analysis (ECASIA), Antibes, France, October, 1989.

S. D. Gardner, C. U. Pittman, Jr. and R. M. Hackett, "Preparation, Characterization and Modeling of Composites with an Elastomeric Polymer Interfacial Zone Chemically Connecting the Fibers to the

Matrix," presented at the Mississippi EPSCoR Planning Conference, The University of Mississippi Medical Center, Jackson, MS, May 20-21, 1991.

S. D. Gardner, "Preparation, Characterization and Modeling of Composites with an Elastomeric Interphase Chemically Connecting the Fibers to the Matrix," presented at NASA Marshall Space Flight Center, Huntsville, AL, September 10, 1991.

S. D. Gardner and C. U. Pittman, Jr. and R. M. Hackett, "Preparation, Characterization and Performance Assessment of Polymeric Composite Materials Containing Stress-Relaxing Elastomers Chemically Bonding the Fibers to the Matrix," presented at the Annual Review Conference of the Mississippi EPSCoR Program, Jackson State University, Jackson, MS, January 27-28, 1992.

S. D. Gardner, C. U. Pittman, Jr. and R. M. Hackett, "A Model Representation of Polymeric Composite Materials Incorporating an Elastomeric Interphase," presented at the Fourth International Conference on Composite Interfaces (ICCI-IV), Case Western Reserve University, Cleveland, Ohio, May 26-29, 1992.

S. D. Gardner and C. U. Pittman, Jr., "Studies to Advance Composite Materials Research: Polymer Composites Containing Stress-Relaxing Elastomers Chemically Bonding the Fibers to the Matrix," presented at the Annual Review Conference of the Mississippi EPSCoR Program, Mississippi State University, Mississippi State, MS, January 26-27, 1993.

S. D. Gardner and C. U. Pittman, Jr., "An Overview of Composites Research at Mississippi State University: Polymer Composites Containing Stress-Relaxing Elastomers Chemically Bonding the Fibers to the Matrix," presented at Amoco Performance Products, Inc., Alpharetta, GA, March 2, 1993.

S. D. Gardner, Mississippi EPSCoR Advanced Development Program Planning Conference, University of Mississippi, Oxford, MS, attended August 10-11, 1993.

S. D. Gardner, "Mechanisms of Adhesive Bonding in Layered Structures: A Model Investigation to Correlate the Adhesion Quality and the Ultrasonic NDE Signature," presented at Lockheed Aeronautical Systems Company, Marietta, GA, October 25, 1993.

S. D. Gardner, Mississippi NSF-EPSCoR Annual Review Conference, University of Mississippi Medical Center, Jackson, MS, attended January 12-13, 1994.

S. D. Gardner, 17th Annual Meeting of the Adhesion Society, Orlando, FL, attended February 20-23, 1994.

S. D. Gardner, "Engineered Interphases in Carbon Fiber Composites and Adhesive Bonds," presented to U.S. Army representatives visiting Mississippi State University, March 8, 1994.

S. D. Gardner, "The Application of X-ray Photoelectron Spectroscopy (XPS) and Ion Scattering Spectroscopy (ISS) to the Study of Carbon Fibers and Their Composites," presented to Graduate Student Seminar, Department of Chemical Engineering, Mississippi State University, March 10, 1994.

S. D. Gardner, "Research Activities in the Mississippi Composite Materials Cluster: A Review of Research Objectives and Focus Areas," presented to Dr. Edmund G. Henneke (Dean, College of Engineering, Virginia Tech) during the NSF EPSCoR planning conference, Mississippi State University, May 2, 1994.

S. D. Gardner, "The Application of X-ray Photoelectron Spectroscopy (XPS) and Ion Scattering Spectroscopy (ISS) to the Study of Carbon Fibers and Their Composites," presented at the 12th Biannual Meeting of the NASA SPIP Committee on Carbon Phenolic Constituent and Composite Test Methodology, Mississippi State University, May 19, 1994.

S. D. Gardner, B. Y. Low, C. U. Pittman and R. M. Hackett, "A Model Representation of the Interphase in Fiber-Reinforced Composites: Acknowledgment of Property Gradients," presented at the Fifth International Conference on Composite Interfaces (ICCI-5), Chalmers University of Technology, Göteborg, Sweden, June 20-23, 1994.

S. D. Gardner, C. S. K. Singamsetty, G. Booth and C. U. Pittman, "A Surface Characterization Study of Carbon Fibers Using Angle-Resolved XPS and ISS," presented at the Fifth International Conference on Composite Interfaces (ICCI-5), Chalmers University of Technology, Göteborg, Sweden, June 20-23, 1994.

S. D. Gardner, B. Y. Low, C. U. Pittman and R. M. Hackett, "A Model Representation of the Interphase in Fiber-Reinforced Composites: Acknowledgment of Property Gradients," presented at the First International Conference on Composites Engineering (ICCE-1), New Orleans, Louisiana, August 28-31, 1994.

S. D. Gardner, "The Engineering of Surfaces and Interfaces in Composites," presented at the Chemical Engineering Advisory Committee Meeting, Department of Chemical Engineering, Mississippi State University, Mississippi State, MS, November 4, 1994.

S. D. Gardner, 18th Annual Meeting of the Adhesion Society, Hilton Head, S.C., attended February 19-22, 1995.

S. D. Gardner, C. S. K. Singamsetty, G. He and C. U. Pittman, Jr., "Reacting Tetraethylenepentamine with Nitric-Acid-Oxidized Carbon Fibers: An XPS/ISS Investigation," presented at the Second International Conference on Composites Engineering (ICCE-2), New Orleans, Louisiana, August 21-24, 1995.

S. D. Gardner, C. S. K. Singamsetty, E. D. Perakslis, Z. Wu and C. U. Pittman, Jr., "An XPS/ISS Characterization of Carbon Fibers Sequentially Exposed to Nitric Acid and Sodium Hydroxide," presented at the Second International Conference on Composites Engineering (ICCE-2), New Orleans, Louisiana, August 21-24, 1995.

W. Li, C. U. Pittman, Jr. and S. D. Gardner, "Composites with Chemically Bound Elastomeric Interphases at the Fiber-Matrix Interface," presented at the Second International Conference on Composites Engineering (ICCE-2), New Orleans, Louisiana, August 21-24, 1995.

S. D. Gardner, "Engineered Interphases in Composite Materials: The Application of X-ray Photoelectron Spectroscopy (XPS) and Ion Scattering Spectroscopy (ISS) to the Study of Carbon Fiber Adhesion." An invited seminar presented to the Department of Chemical Engineering, University of Florida, Gainesville, Florida, September 11, 1995.

S. D. Gardner, "Engineered Interphases in Composite Materials: The Application of X-ray Photoelectron Spectroscopy (XPS) and Ion Scattering Spectroscopy (ISS) to the Study of Carbon Fiber Adhesion." An invited seminar presented to the Department of Chemical Engineering, Tulane University, New Orleans, Louisiana, January 19, 1996.

S. D. Gardner, Mississippi EPSCoR Conference, Jackson, MS, attended January 31, 1996.

S. D. Gardner, E. D. Perakslis, and C. U. Pittman, Jr., "Surface Composition of Carbon Fibers Subjected to Oxidation in Nitric Acid Followed by Oxygen Plasma," presented at the Fourth International Conference on Adhesion and Surface Analysis, Loughborough University, UK, April 16-18, 1996.

C. U. Pittman, Jr., G. He, W. Jiang and S. D. Gardner, "Surface Chemistry of Carbon Fibers after Electrochemical and Plasma Oxidation," presented at the Third International Conference on Composites Engineering (ICCE-3), New Orleans, Louisiana, July 21-26, 1996.

S. D. Gardner, E. D. Perakslis and C. U. Pittman, Jr., "Carbon Fiber Surface Oxidation: Synergism of Nitric Acid and Oxygen Plasma Treatments," presented at the Third International Conference on Composites Engineering (ICCE-3), New Orleans, Louisiana, July 21-26, 1996.

S. D. Gardner, 1996 Annual Meeting of the American Institute of Chemical Engineers, Chicago, IL, attended November 10-15.

S. D. Gardner, Mississippi EPSCoR Conference, Jackson, MS, attended January 28-29, 1997.

J. Dagnall, S. Loftin, B. Srinivasan and S. D. Gardner, "Semiconductor Gas Sensors for Carbon Monoxide Detection: A Comparison Between Au/MnO_x and Pt/SnO₂," presented at the 1997 Annual Meeting of the American Institute of Chemical Engineers, Los Angeles, CA, November 16-21.

S. D. Gardner, "The Application of XPS and ISS toward Carbon Fibers and their Adhesion to Polymer Matrices," presented at the Spring 1998 Mississippi EPSCoR Conference, Jackson, MS, January 22.

J. D. Bumgardner, M. Roach, T. Scheel and S. D. Gardner, "Corrosion and XPS Surface Evaluation of Nickel-Chromium Based Dental Casting Alloys," presented at the 14th Southern Biomedical Engineering Conference, San Antonio, TX, February, 1998.

J. Dagnall, S. Loftin, B. Srinivasan and S. D. Gardner, "Sensitivity and Selectivity of Au/MnO_x Semiconductor Gas Sensors for Carbon Monoxide Detection," paper presented at the 1998 Spring National Meeting of the American Institute of Chemical Engineers, New Orleans, LA, March 8-12.

W. Jiang, Z. R. Yue, C. U. Pittman, S. D. Gardner, L. Wang, H. Toghiani and C. A. Leon y Leon, "Surface Properties of Electrochemically Oxidized Carbon Fibers," presented at the 214th National Meeting of the American Chemical Society, Dallas, TX, March 29-April 12, 1998.

M. Roach, S. D. Gardner, D. Parcell and J. D. Bumgardner, "Comparison of Nickel-Chromium Dental Alloys Before and After Porcelain Firing," presented at the International Biological Engineering Conference, Orlando, FL, July 10-12, 1998.

J. D. Bumgardner, M. D. Roach, S. D. Gardner and J. L. Ong, "Surface Analysis of Commercial HA Coatings on Dental Implants," presented at the 1999 Annual Meeting of the Society for Biomaterials, Providence, RI, April 28-May 2.

S. D. Gardner, "Surface Analysis Techniques and Their Applications in Oxidation Catalysis," presented to the Technical Department at Bush Boake Allen, Inc., Jacksonville, FL, October 16, 1998.

S. D. Gardner, attended the 1998 Annual Meeting of the American Institute of Chemical Engineers, Miami Beach, FL, November 16-20.

S. D. Gardner, attended the 2000 Spring National Meeting of the American Institute of Chemical Engineers, Atlanta, GA, March 5-9.

S. D. Gardner, attended the 2017 Materials Research Society meeting, Boston, MA, November 26 – December 1.

S. D. Gardner, "PTFE Membrane Science and Technology." An invited seminar presented to the Department of Chemical Engineering, University of Florida, Gainesville, Florida, April 22, 2019.

K. Ashkar, S. Darvishmanesh and S. Gardner, "Development of High-Performance 30-nm NIPS PTFE Membrane," presented at the 2023 North American Membrane Society annual meeting, University of Alabama, Tuscaloosa, Alabama, May 13-17.

K. Ashkar, S. Darvishmanesh and S. Gardner, "Development of High-Performance 30-nm NIPS PTFE Membrane," presented at the 2023 Annual Meeting of the American Institute of Chemical Engineers, Orlando, FL, November 7, 2023.

REFEREED PUBLICATIONS (40 TOTAL)

S. D. Gardner, G. B. Hoflund, M. R. Davidson and D. R. Schryer, "Evidence of Alloy Formation during the Reduction of Platinized Tin Oxide Surfaces," ***Journal of Catalysis***, **115** (1989) 132.

S. D. Gardner, G. B. Hoflund and D. R. Schryer, "Surface Characterization Study of the Reduction of an Air-Exposed Pt₃Sn Alloy: Part IV," ***Journal of Catalysis***, **119** (1989) 179.

J. E. Drawdy, G. B. Hoflund, S. D. Gardner, E. Yngvadottir and D. R. Schryer, "Effect of Pretreatment on a Platinized Tin Oxide Catalyst Used for Low-Temperature CO Oxidation," ***Surface and Interface Analysis***, **16** (1990) 369.

S. D. Gardner, G. B. Hoflund, D. R. Schryer, J. Schryer, B. T. Upchurch and D. R. Brown, "The Catalytic Behavior of Noble Metal/Reducible Oxide Materials for Low-Temperature CO Oxidation: Part 1 - Comparison of Catalyst Performance," ***Langmuir***, **7**(10) (1991) 2135.

S. D. Gardner, G. B. Hoflund, D. R. Schryer and B. T. Upchurch, "Characterization Study of Silica-Supported Platinized Tin Oxide Catalysts Used for Low-Temperature CO Oxidation: Effect of Pretreatment Temperature," ***Journal of Physical Chemistry***, **95** (1991) 835.

S. D. Gardner, G. B. Hoflund, B. T. Upchurch, D. R. Schryer, J. Schryer and E. J. Kielin, "Comparison of the Performance Characteristics of Low-Temperature CO Oxidation Catalysts," ***Journal of Catalysis***, **129** (1991) 114.

S. D. Gardner, G. B. Hoflund, M. R. Davidson, H. A. Laitinen, D. R. Schryer and B. T. Upchurch, "The Catalytic Behavior of Noble Metal/Reducible Oxide Materials for Low-Temperature CO Oxidation: Part 2 - Surface Characterization of Au/MnO_x," ***Langmuir***, **7**(10) (1991) 2140.

S. D. Gardner, C. U. Pittman, Jr. and R. M. Hackett, "Polymeric Composite Materials Incorporating an Elastomeric Interphase: A Mathematical Assessment," **Composites Science and Technology**, **46**(4) (1993) 307.

S. D. Gardner, C. U. Pittman, Jr. and R. M. Hackett, "Residual Thermal Stresses in Filamentary Polymer-Matrix Composites Containing an Elastomeric Interphase," **Journal of Composite Materials**, **27**(8) (1993) 830.

B. Y. Low, S. D. Gardner, C. U. Pittman, Jr. and R. M. Hackett, "A Micromechanical Characterization of Graphite Fiber/Epoxy Composites Containing a Heterogeneous Interphase Region," **Composites Science and Technology**, **52** (1994) 589.

G. B. Hoflund, S. D. Gardner, D. R. Schryer, B. T. Upchurch, J. Schryer and E. J. Kielin, "Performance Characteristics of Low-Temperature CO Oxidation Catalysts," **Materials Research Society Symposium Proceedings**, **368** (1995) 139.

S. D. Gardner, C. U. Pittman, Jr., T. C. Chang, B. Y. Low and R. M. Hackett, "Microstress Distribution in Graphite Fiber/Epoxy Composites Containing an Elastomeric Interphase: Response to Uniaxial and Biaxial Loading Conditions," **Composites**, **26**(4) (1995) 269.

S. D. Gardner, C. S. K. Singamsetty, G. L. Booth, G. R. He and C. U. Pittman, Jr., "Surface Characterization of Carbon Fibers Using Angle-Resolved XPS and ISS," **Carbon**, **33**(5) (1995) 587.

B. Y. Low, S. D. Gardner, C. U. Pittman, Jr. and R. M. Hackett, "A Micromechanical Characterization of Residual Thermal Stresses in Carbon Fiber/Epoxy Composites Containing a Non-Uniform Interphase Region," **Composites Engineering**, **5**(4) (1995) 375.

Z. Wu, C. U. Pittman, Jr. and S. D. Gardner, "Nitric Acid Oxidation of Carbon Fibers and the Effects of Subsequent Treatment in Refluxing Aqueous NaOH," **Carbon**, **33**(5) (1995) 597.

Z. Wu, C. U. Pittman, Jr. and S. D. Gardner, "Bonding Epoxide Functions to Nitric Acid-Oxidized Carbon Fibers Using Epichlorohydrin; A Reliable Analytical Determination of Epoxide Functions on Fiber Surfaces," **Carbon**, **33**(5) (1995) 607.

K. Balasubramaniam, S. D. Gardner and Y. Ji, "A Study on the Influence of Fiber-Matrix Interphase Properties on Ultrasonic Wave Behavior Using Effective Elastic Property Models," **Composites Engineering**, **5**(6) (1995) 675.

B. Y. Low, K. L. Anderson, M. Vincent, S. D. Gardner, C. U. Pittman, Jr. and R. M. Hackett, "Toughened Carbon Fiber/Epoxy Composites: The Relative Influence of an Elastomer Interphase and Elastomer Dispersed in the Matrix," **Composites Engineering**, **5**(4) (1995) 437.

G. B. Hoflund, S. D. Gardner, D. R. Schryer, B. T. Upchurch and E. J. Kielin, "Au/MnO_x Catalytic Performance Characteristics for Low-Temperature Carbon Monoxide Oxidation," **Applied Catalysis B: Environmental**, **6** (1995) 117.

C. U. Pittman, Jr., S. D. Gardner, G. He, L. Wang, Z. Wu, C. S. K. Singamsetty, B. Wu and G. Booth, **Proceedings of the Spring 1995 Materials Research Society Meeting**, San Francisco, CA, April 17-21, 1995, Vol. 385: Polymer/Inorganic Interfaces II, p. 195.

G. B. Hoflund, S. D. Gardner, D. R. Schryer, B. T. Upchurch and E. J. Kielin, "Effect of CO₂ on the Performance of Au/MnO_x and Pt/SnO_x Low-Temperature CO Oxidation Catalysts," *Langmuir*, **11** (1995) 3431.

Z. Wu, C. U. Pittman, Jr. and S. D. Gardner, "Grafting Isocyanate-Terminated Elastomers onto the Surfaces of Carbon Fibers: Reaction of Isocyanate with Acidic Surface Functions," *Carbon*, **34** (1996) 59.

S. D. Gardner, C. S. K. Singamsetty, Z. Wu and C. U. Pittman, Jr., "XPS/ISS Characterization of Carbon Fibers Sequentially Exposed to Nitric Acid and Sodium Hydroxide," *Surface and Interface Analysis*, **24** (1996) 311.

S. D. Gardner, G. He and C. U. Pittman, Jr., "A Spectroscopic Examination of Carbon Fiber Cross Sections Using XPS and ISS," *Carbon*, **34** (1996) 1221.

E. D. Perakslis, S. D. Gardner, and C. U. Pittman, Jr., "Surface Composition of Carbon Fibers Subjected to Oxidation in Nitric Acid Followed by Oxygen Plasma," *Journal of Adhesion Science and Technology*, **11** (1997) 531-551.

G. B. Hoflund, S. D. Gardner, D. R. Schryer, B. T. Upchurch and E. J. Kielin, "Influence of Promoters on the Performance of Au/MnO_x and Pt/SnO_x/SiO₂ Low-Temperature CO Oxidation Catalysts," *Reaction Kinetics Catalysis Letters*, **58** (1996) 19.

S. D. Gardner, C. S. K. Singamsetty, G. He and C. U. Pittman, Jr., "Chemical Bonding of Tetraethylenepentamine to Nitric-Acid-Oxidized Carbon Fibers: An XPS/ISS Investigation," *Applied Spectroscopy*, **51** (1997) 636-648.

C. U. Pittman, Jr., Z. Wu, W. Jiang, G. He, B. Wu, W. Li and S. D. Gardner, "Reactivities of Amine Functions Grafted to Carbon Fiber Surfaces by Tetraethylenepentamine. Designing Interfacial Bonding," *Carbon*, **35** (1997) 929-943.

C. U. Pittman, Jr., G. He, B. Wu and S. D. Gardner, "Chemical Modification of Carbon Fiber Surfaces by Nitric Acid Oxidation Followed by Reaction with Tetraethylenepentamine," *Carbon*, **35** (1997) 317-331.

C. U. Pittman, Jr., G. He, B. Wu, and S. D. Gardner, "Titration of Tetraethylenepentamine (TEPA) phenylisocyanate reaction products: A model correction factor for determination of TEPA grafted to carbon surfaces," *Carbon*, **35** (1997) 333-340.

C. U. Pittman, Jr., W. Jiang, G. He, and S. D. Gardner, "Oxygen Plasma and Isobutylene Plasma Treatments of Carbon Fibers: Determination of Surface Functionality and Effects on Composite Properties," *Carbon*, **36** (1998) 25-37.

S. F. Waseem, S. D. Gardner, G. He, W. Jiang and C. U. Pittman, Jr., "Adhesion and Surface Analysis of Carbon Fibers Electrochemically Oxidized in Potassium Nitrate," *J. Materials Science*, **33** (1998) 3151-3162.

B. Srinivasan and S. D. Gardner, "An Investigation of the Gas Sensing Properties of Au/MnO_x: Response to CO Exposure and Comparison to Pt/SnO₂," *Surface and Interface Analysis*, **26** (1998) 1035-1049.

Z. Xu, N. S. Losure and S. D. Gardner, "Epoxy Resin Filled with Tire Rubber Particles Modified by Plasma Surface Treatment," **J. Advanced Materials**, **30** (1998) 11-18.

M. Roach, D. Parsell, S. Gardner and J. D. Bumgardner, "Correlation of Corrosion and Surface Analysis for Ni-Cr Alloys," **Critical Reviews in Biomedical Engineering**, **26** (1998) 391-392.

C. U. Pittman, Jr., W. Jiang, Z. R. Yue, S. D. Gardner, LiChang Wang, Hossein Toghiani and Carlos. A. Leon y Leon, "Surface Properties of Electrochemically Oxidized Carbon Fibers," **Carbon**, **37** (1999) 1797-1807.

Z. R. Yue, W. Jiang, L. Wang, H. Toghiani, S. D. Gardner and C. U. Pittman, Jr., "Adsorption of Precious Metal Ions onto Electrochemically Oxidized Carbon Fibers," **Carbon**, **37** (1999) 1607-1618.

Z. R. Yue, W. Jiang, L. Wang, S. D. Gardner and C. U. Pittman, Jr., "Surface Characterization of Electrochemically Oxidized Carbon Fibers," **Carbon**, **37** (1999) 1785-1796.

S. D. Gardner, "Enhanced Utilization of Hand Refractometers in Brewing Operations," **The New Brewer**, **17**(4) (2000) 44-47.

J. Iranmahboob, S. D. Gardner, H. Toghiani and D. O. Hill, "XPS Study of Molybdenum Sulfide Catalyst Exposed to CO and H₂," **J. Colloid and Interface Science**, **270**(1) (2004) 124-126.

RESEARCH GRANTS AWARDED

Title: Engineering Research Equipment: Acquisition of an X-ray Photoelectron Spectroscopy Instrument. *Investigators:* S.D. Gardner (P.I.) and C.U. Pittman, Jr. *Sponsor:* National Science Foundation. *Award Date:* 01 September 1992. *Amount:* \$221,000.

Title: Engineering Research Instrumentation: Acquisition of an Ultrahigh Vacuum Specimen Preparation Chamber. *Investigator:* S.D. Gardner. *Sponsor:* Advanced Research Projects Agency (ARPA). *Award Date:* 02 July 1993. *Amount:* \$50,000.

Title: Experimental Systematic Initiative. *Investigators:* S.D. Gardner (P.I.) and C.U. Pittman, Jr. *Sponsor:* National Science Foundation. *Award Date:* 01 November 1993. *Amount:* \$23,332.

Title: 1994 Exploratory Research Grants: An Investigation of the Gas Sensing Properties of a Novel Manganese-Oxide-Supported Gold Catalyst. *Investigator:* S.D. Gardner. *Sponsor:* Environmental Protection Agency. *Award Date:* 12 October 1995. *Amount:* \$103,770.

Title: Surface Characterization Studies Relating to the Quality Control of Steel and Bronze Wires. *Investigator:* S.D. Gardner. *Sponsor:* Delta Wire Corporation. *Award Date:* 01 July 1996. *Amount:* \$10,000.

Title: Surface Characterization Studies Relating to the Quality Control of Steel and Bronze Wires. *Investigator:* S.D. Gardner. *Sponsor:* Delta Wire Corporation. *Award Date:* 01 January 1997. *Amount:* \$10,000.

Title: Performance of XPS Surface Analyses. *Investigator:* S.D. Gardner. *Sponsor:* Pelican Products. *Award Date:* 01 October 1997. *Amount:* \$4,000.

Title: Surface Analysis for Quality Control of Wallpaper Adhesives. *Investigator:* S.D. Gardner.
Sponsor: GenCorp Polymer Products. *Award Date:* 01 November 1997. *Amount:* \$2,000.

MEMBERSHIP ON THESIS/DISSERTATION COMMITTEES

Student: Dana Ladnier. *Degree:* Master of Science in Engineering. *Department:* Aerospace Engineering. *Status:* degree awarded summer, 1992.

Student: Guoren He. *Degree:* Doctor of Philosophy. *Department:* Chemical Engineering. *Status:* degree awarded summer, 1994.

Student: Venkata N. Gunda. *Degree:* Master of Science in Engineering. *Department:* Chemical Engineering. *Status:* degree awarded fall, 1994.

Student: Fang Yuan. *Degree:* Master of Science in Engineering. *Department:* Chemical Engineering. *Status:* degree awarded fall, 1995.

Student: Shyh-Ming Chen. *Degree:* Master of Science in Engineering. *Department:* Chemical Engineering. *Status:* degree awarded fall, 1995.

Student: Yuyin Ji. *Degree:* Master of Science in Engineering. *Department:* Aerospace Engineering. *Status:* degree awarded summer, 1996.

Student: Javed Warsi. *Degree:* Master of Science in Engineering. *Department:* Chemical Engineering. *Status:* degree awarded spring, 1996.

Student: Xiaolin Wu. *Degree:* Master of Science in Engineering. *Department:* Chemical Engineering. *Status:* degree awarded summer, 1996.

Student: Zhihong Wu. *Degree:* Doctor of Philosophy. *Department:* Chemistry. *Status:* degree awarded summer, 1997.

Student: Zhenglian Xu. *Degree:* Master of Science in Engineering. *Department:* Chemical Engineering. *Status:* degree awarded spring, 1996.

Student: Sikha Srinivasan. *Degree:* Master of Science in Engineering. *Department:* Chemical Engineering. *Status:* degree awarded spring, 1997.

Student: Jamshid Iranmaboob. *Degree:* Doctor of Philosophy. *Department:* Chemical Engineering. *Status:* degree awarded spring, 1998.

THESES/DISSERTATIONS DIRECTED

Student: Wei Li. *Degree:* Master of Science in Engineering. *Department:* Chemical Engineering. *Status:* degree awarded spring, 1995.

Student: Wei Li. *Degree:* Doctor of Philosophy. *Department:* Chemical Engineering. *Status:* degree awarded spring, 1997.

Student: Boon Y. Low. *Degree:* Master of Science in Engineering. *Department:* Chemical Engineering. *Status:* degree awarded fall, 1994.

Student: Chakravarthy S.K. Singamsetty. *Degree:* Master of Science in Engineering. *Department:* Chemical Engineering. *Status:* degree awarded fall, 1995.

Student: Eric D. Perakslis. *Degree:* Master of Science in Engineering. *Department:* Chemical Engineering. *Status:* degree awarded spring, 1996.

Student: Syed F. Waseem. *Degree:* Master of Science in Engineering. *Department:* Chemical Engineering. *Status:* degree awarded spring, 1997.

Student: Glyn L. Booth. *Degree:* Master of Science in Engineering. *Department:* Chemical Engineering. *Status:* degree awarded spring, 1997.

Student: Bharat Srinivassan. *Degree:* Master of Science in Engineering. *Department:* Chemical Engineering. *Status:* degree awarded summer, 1997.

MISCELLANEOUS SCHOLARLY ACTIVITIES

External reviewer for the *National Science Foundation, Journal of Catalysis, Composites Engineering, Chemistry of Materials, Surface and Interface Analysis* and the *College of Engineering* at Mississippi State University.

Mentor to high school students attending the Mississippi School of Math and Science. (Fall, 1993; Spring, 1994; Spring, 1996).

Chaired (by invitation) a session entitled "Chemical Behavior of Composites" at the Second International Conference on Composites Engineering (ICCE-2), 21-24 August 1995, New Orleans, LA, USA.

Chaired (by invitation) a session entitled "Chemical and Coatings II " at the Third International Conference on Composites Engineering (ICCE-3), 21-26 July 1996, New Orleans, LA, USA.

Mentored students during participation in the Great Heat Transfer Challenge (fall, 1996), a national design competition sponsored by Monsanto Corporation. *The design won first place.*

Promoted to faculty advisor for the MSU chapter of the American Institute of Chemical Engineers (AIChE) during the 1997 fall semester.

Mentored students in the National Poster Paper contest held at the 1997 Annual Conference of the American Institute of Chemical Engineers, Los Angeles, CA, November, 16-21. *The paper won 2nd place.*

PROFESSIONAL DEVELOPMENT ACTIVITIES/HONORS

3-M Fellowship - 1987. Amount: \$5,000.

Attended a short course sponsored by the American Chemical Society entitled "High Performance Polymeric Adhesives and Composites," Virginia Tech, Blacksburg, VA, September 30 - October 5, 1990.

Attended a teleconference on March 21, 1991, entitled "Obtaining Funding for Faculty Research," by Dr. Marshall H. Kaplan.

Oak Ridge Associated Universities 1993 Junior Faculty Enhancement Award. Amount: \$10,000.

Granted membership in the International Community for Composites Engineering (ICCE) in August, 1994.

Completed a course entitled "PHA Leader Training Course: What-If Method" administered by Battelle Corporation, Jacksonville, FL, September 22-24, 1999.

Completed an AIChE Short Course entitled "Automatic Control of Processes," Orlando, FL, October 22-24, 2001.

Achieved Six-Sigma black belt certification under the direction of Millennium Specialty Chemicals, Baltimore, MD, February-June, 2003.

Received the "Operational Excellence Award" from LyondellBasell for contributions toward optimizing dihydromyrcenol production at the Jacksonville plant, March, 2006.

Achieved "Session Leader" certification in Apollo Root Cause Analysis, LyondellBasell, Jacksonville, FL, February, 2008.

Completed an AIChE Short Course entitled "Gas Chromatography: Fundamentals, Troubleshooting, and Method Development," Chicago, IL, August 22-26, 2011.

Completed an AIChE Short Course entitled "High-Pressure Liquid Chromatography: Fundamentals, Troubleshooting and Method Development," Chicago, IL, September 12-16, 2011.

Completed a training course on the theory and use of slot dies for coatings, The Coating Tech Institute, Cleveland, OH, October 17-19, 2023.