

PETER SCHWARTZ  
Professor & Head  
Department of Polymer & Fiber Engineering  
Samuel Ginn College of Engineering  
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#### *RESEARCH INTERESTS*

*Mechanics of Fibrous Assemblies:* stochastic models for fabric mechanics; fabric properties and performance; braids and ropes.

*Mechanics of Fiber-Reinforced Composite Materials:* micromechanics of failure processes; creep-rupture of microcomposites; mechanics of hybrid composites; Monte Carlo simulations.

*Polymers and Plastics:* electrostatic spinning, recycling of textile materials; characterization techniques.

*Interfaces and Adhesion:* inductively coupled gas plasmas; plasma polymerization; surface modifications of fibers; characterization techniques.

#### *EDUCATION*

*Ph.D.* [Fiber & Polymer Science], 1981, North Carolina State University, Raleigh, NC.

*M.A.* [Mathematics], 1972, University of Pittsburgh, Pittsburgh, PA.

*M.S.* [Engineering Mechanics], 1970, Georgia Institute of Technology, Atlanta, GA.

*B. Eng.* [Textile Engineering], 1968, Georgia Institute of Technology, Atlanta, GA.

#### *PROFESSIONAL EXPERIENCE*

*Professor & Head*, Department of Polymer and Fiber Engineering, Auburn University, Auburn, AL, 2006-present

*Professor & Head*, Department of Textile Engineering, Auburn University, Auburn, AL, 2001-2005

*Professor Emeritus*, Department of Textiles and Apparel, Cornell University, Ithaca, NY, 2002-present

*Professor*, Department of Textiles and Apparel, Cornell University, Ithaca, NY, 1994-2002

*Gastprofessor*, Ab. Kunststoffe und Verbundwerkstoffe, Technische Universität Hamburg-Harburg, Hamburg, DE, October 1997-February 1998

*Faculty*, Bioengineering Program, Cornell University, 1996-2001

*Editorial Board*, *Advanced Composites Letters*, 1993-present

*Director of Undergraduate Studies*, Department of Textiles and Apparel, 1992-1999

*Faculty*, Program in Biology and Society, Cornell University, 1990-2001

*Visiting Associate Professor*, Department of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, MA, January-July 1989

*Associate Professor (with indefinite tenure)*, Department of Textiles and Apparel, Cornell University, Ithaca, NY, 1987-1994

*Assistant Professor*, Department of Textiles and Apparel, Cornell University, Ithaca, NY, 1982-1987

*Member*, Center for Manufacturing Enterprise, Cornell University, 1993-2001

*Instructor*, Department of Textile Materials and Management, North Carolina State University, Raleigh, NC, 1976-1982

*Part-Time Instructor*, Crawford County Vocational-Technical School, Meadville, PA, 1974-1975

*Senior Engineer*, Product Design and Manufacturing Engineering, Talon/TEXTRON, Meadville, PA, 1972-1976

*Teaching Fellow*, Department of Mathematics, University of Pittsburgh, Pittsburgh, PA, 1971-1972

*Teaching Assistant*, Departments of Mechanical Engineering and Industrial Engineering, University of Pittsburgh, Pittsburgh, PA, 1970-1971

*Teaching Assistant*, Department of Mathematics, Georgia Institute of Technology, Atlanta, GA, 1969-1970

*Textile Engineer*, Fiber Glass Research, PPG Industries, Harmar Twp., PA, 1968

#### *HONORS, PRIZES, AND AWARDS*

Gamma Sigma Delta Distinguished Research Award, 1995

ASTM Committee D-13 Harold DeWitt Smith Memorial Award, 1994

Kappa Omicron Nu/Human Ecology Alumni Distinguished Teaching Award, 1993

Andrew D. White Outstanding Faculty Award, 1992

Honor Society of Gamma Sigma Delta, 1991

Fiber Society Distinguished Lecturer, 1990-1991

N. C. State Academy of Outstanding Teachers, 1982

Honor Society of Phi Kappa Phi, 1981

Society of Sigma Xi, 1981

Harry Reimer Honor Award, 1968

#### *PUBLICATIONS*

Ünsal, E., Dane, J. H., Schwartz, P., and Dozier, G.V., "Modeling Displacement Properties of Immiscible Fluids in Porous Media." *Simulation*, **82**, 499-510 (2006).

Ünsal, E., Dane, J. H., and Schwartz, P., "Effect of Liquid Characteristics on Wetting, Capillary Migration and Retention Properties of Fibrous Polymer Networks." *J. Appl. Polym. Sci.*, **97**, 282-292 (2005).

- Ünsal, E., Schwartz, P., and Dane, J., "Role of Capillarity on Penetration into and Flow Through Fibrous Barrier Materials." *J. Appl. Polym. Sci.*, **95**, 841-846 (2005).
- Miller, A. and Schwartz, P., Forced Flow Percolation for Modeling of Liquid Penetration of Barrier Materials. *J. Text. Inst., Part 1*, **92**, 53-62 (2002).
- Hoffmann, M. P., Kuhar, T. P., Baird, J. M., Gardner, J., Schwartz, P., and Shelton, A. M., Nonwoven Fiber Barriers for Control of Cabbage Maggot and Onion Maggot (Diptera: Anthomyiidae). *J. Econ. Entomol.*, **94**, 1485-1491 (2001).
- Kazanci, M., Schwartz, P., and Phoenix, S. L., The Effect of Matrix Stiffness on the Creep-Rupture Lifetime of Carbon Fiber/Epoxy Composites. *Compos. Struct.*, **54**, 221-223 (2001).
- Weber, I. and Schwartz, P., Monitoring Bending Fatigue in Carbon Fiber/Epoxy Composite Strands: A Comparison between Mechanical and Resistance Techniques. *Compos. Sci. Technol.*, **61**, 849-853 (2001).
- Köster, K. and Schwartz, P., Influence of Acetylene Plasma Treatment on the Torsional Fatigue of Carbon Fiber Reinforced Composite Strands. *Compos. Sci. Technol.*, **60**, 2005-2010 (2000).
- Miller, A. and Schwartz, P., A Test Methodology for the Study of Liquid Penetration of Barrier Materials. *Text. Res. J.*, **70**, 77-83 (2000).
- Feih, S. and Schwartz, P., Modification of the Carbon Fiber/Matrix Interface using Gas Plasma Treatment with Acetylene and Oxygen. *J. Adhesion Sci. Technol.*, **12**, 523-529 (1998).
- Lee, P.-T. and Schwartz, P., Torsional Fatigue in Carbon Fiber/Epoxy Strands. *Adv. Compos. Lett.*, **6**, 127-130 (1997).
- Miller, A. and Schwartz, P., Effects of Aging on Plasma Treated Ultra High Strength Polyethylene and the Plasma Treated Ultra High Strength Polyethylene/Epoxy Interface. *Plasmas and Polymers*, **2**, 115-132 (1997).
- Feih, S. and Schwartz, P., FEM Analysis and Comparison of Single Fiber Pull-Out Tests. *Adv. Compos. Lett.*, **6**, 99-102 (1997).
- Straub, A., Slivka, M., and Schwartz, P., Time and Temperature Effects on the Fiber/Matrix Interface Strength using the Microbond Technique. *Compos. Sci. Technol.*, **57**, 991-994 (1997).
- Couillard, R. A. A. and Schwartz, P., Bending Fatigue of Carbon-Fiber-Reinforced Epoxy Composite Strands. *Compos. Sci. Technol.*, **57**, 229-235 (1997).
- Stumpf, H., Schwartz, P., Lienkamp, M., and Schulte, K., S-Glass/Kevlar-149 Hybrid Microcomposites in Stress-Rupture: A Monte Carlo Simulation. *Compos. Sci. Technol.*, **54**, 211-221 (1995).
- Ahn, H. S. and Schwartz, P., Measurement of Interfacial Adhesion in Carbon/Epoxy Composite after Plasma Surface Treatment on Carbon Fibers. *Adv. Compos. Lett.*, **3**, 27-29 (1994).
- Knickrehm, A., Rehm, W., and Schwartz, P., Effect of Argon Plasma Pre-treatment on Adhesion of Epoxy to Aramid Fibers Treated with Oxygen Plasmas. *Adv. Compos. Lett.*, **2**, 211-213 (1993).

- Hild D. N. and Schwartz, P., Plasma Treated Ultra High Strength Polyethylene Fibers for Improved Fracture Toughness of Poly(methyl Methacrylate). *J. Mater. Sci.: Materials in Medicine*, **4**, 481-493 (1993).
- Stumpf, H. and Schwartz, P. A Monte Carlo Simulation of Seven-Fiber Microcomposites in Stress-Rupture. *Compos. Sci. Technol.*, **49**, 251-263 (1993).
- Qiu, Y., DeFlon, S., and Schwartz, P., Plasma Treatment of Poly(*p*-phenylene benzobisthiozol) Fibers for Improved Adhesion with Epoxy. *J. Adhesion Sci. Technol.*, **7**, 1041-1049 (1993).
- Sastry, A. M., Phoenix, S. L., and Schwartz, P., Analysis of Interfacial Failure in a Composite Microbundle Pull-Out Experiment. *Compos. Sci. Technol.*, **48**, 237-251 (1993).
- Qiu, Y. and Schwartz, P. Single Fiber Pullout from a Microcomposite Test. *Compos. Sci. Technol.*, **48**, 5-10 (1993).
- Qiu, Y. and Schwartz, P., Micromechanical Behaviour of Kevlar149/S-Glass Hybrid Seven Fiber Microcomposite: II. Stochastic Modeling of Stress-Rupture of Hybrid Composite. *Compos. Sci. Technol.*, **47**, 303-316 (1993).
- Qiu, Y. and Schwartz, P., Micromechanical Behaviour of Kevlar149/S-Glass Hybrid Seven Fiber Microcomposite: I. Tensile Strength of the Hybrid Composite. *Compos. Sci. Technol.*, **47**, 289-302 (1993).
- Seo, M. H., Realff, M. L., Pan, N., Boyce, M. C., Schwartz, P., and Backer, S., Mechanical Properties of Fabrics Woven from Yarns Produced by Different Spinning Technologies: Yarn Failure in Woven Fabric. *Text. Res. J.*, **63**, 123-134, (1993).
- Lienkamp, M. and Schwartz, P., A Monte Carlo Simulation of the Failure of a 7-Fiber Microcomposite. *Compos. Sci. Technol.*, **46**, 139-146 (1993).
- Hild, D. N. and Schwartz, P., Plasma Treated Ultra-High Strength Polyethylene Fibers. Part I: Characterization by Electron Spectroscopy for Chemical Analysis. *J. Adhesion Sci. Technol.*, **6**, 879-896 (1992).
- Hild, D. N. and Schwartz, P., Plasma Treated Ultra-High Strength Polyethylene Fibers. Part II: Mechanical Properties of PMMA Composites. *J. Adhesion Sci. Technol.*, **6**, 897-921 (1992).
- Toney, M. and Schwartz, P., Bending and Torsional Fatigue of Nylon 66 Monofilaments. *J. Appl. Polym. Sci.*, **46**, 2023-2032 (1992).
- Heirigs, L. T. and Schwartz, P., The Properties of Small Diameter Aramid Double Braids: Fatigue Lifetime, Strength Retention after Abrasion, and Strength Modeling. *Text. Res. J.*, **62**, 397-402 (1992).
- Qiu, Y. and Schwartz, P., Studies of the Fiber Matrix Interface in Composites Using a New Method: Single Fiber Pull-Out from a Microcomposite. *J. Adhesion Sci. Technol.*, **5**, 741-756 (1991).
- Gulino, R., Schwartz, P., and Phoenix, S. L., Experiments on Shear Deformation, Debonding and Local Load Transfer in a Model Graphite/Glass/Epoxy Microcomposite. *J. Mater Sci.*, **26**, 6655-6672 (1991).

- Küpper, K. and Schwartz, P., Modification of Fiber/Matrix Interface of *p*-Aramid Fibers Using Gas Plasmas. *J. Adhesion Sci. Technol.*, **5**, 165-176 (1991).
- Realff, M. L., Seo, M., Boyce, M. C., Schwartz, P., and Backer, S., On the Mechanical Properties of Fabrics Woven from Yarns Produced by Different Spinning Technologies: Yarn Failure as a Function of Gauge Length. *Text. Res. J.*, **61**, 517-530 (1991).
- Boyce, M. C., Palmer, M. L., Seo, M. H., Schwartz, P., and Backer, S., A Model of the Tensile Failure Process in Woven Fabrics. *J. Appl. Polym. Sci.: Appl. Polym. Symp.*, **47**, 383-402 (1991).
- Holmes, S. and Schwartz, P., Amination of Ultra-High Strength Polyethylene using Ammonia Plasma. *Compos. Sci. Technol.*, **38**, 1-21 (1990).
- Netravali, A. N., Phoenix, S. L., and Schwartz, P., Study of Interfaces of High Performance Glass Fibers and DGEBA Based Epoxy Resins using Single-Fiber-Composite Test. *Polym. Compos.*, **10**, 385-388 (1989).
- Sampathkumar, V. and Schwartz, P., The Effect of Salt Water Immersion on the Ultimate Tensile Strength of Small Diameter Aramid Braids. *Text. Res. J.*, **59**, 94-97 (1989).
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- Shahpurwala, A. A. and Schwartz, P., Modeling Woven Fabric Tensile Strength using Statistical Bundle Theory. *Text. Res. J.*, **59**, 26-32 (1989).
- Phoenix, S. L., Schwartz, P., and Robinson, H. H., IV, Statistics for the Strength and Lifetime in Creep-Rupture of Model Carbon/Epoxy Composites. *Compos. Sci. Technol.*, **32**, 81-120 (1988).
- Wu, H. F., Phoenix, S.L., and Schwartz, P., Temperature Dependence of Lifetime Statistics for Single Kevlar 49 Filaments in Creep-Rupture. *J. Mater. Sci.*, **23**, 1851-1860 (1988).
- Weinberg, A. and Schwartz, P., Twist Effects on the Mechanical Behavior of Kevlar 29/Epoxy Strands. *J. Mater. Sci. Lett.*, **6**, 832-834 (1987).
- Robinson, IV, H., Wu, H. F., Ames, M., and Schwartz, P., An Improved Circuit Design for Self-Resonating Vibrosopes. *Rev. Sci. Instrum.*, **58**, 436-440 (1987).
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- Pourdeyhimi, B., Wagner, H. D., and Schwartz, P., A Comparison of Mechanical Properties of Discontinuous Kevlar 29 Fibre Reinforced Bone and Dental Cements. *J. Mater. Sci.*, **21**, 4468-4474 (1986).

- Schwartz, P., Netravali, A. and Sembach, S., The Effects of Strain Rate and Gauge Length on the Failure of Ultra-High Strength Polyethylene Fibers. *Text. Res. J.*, **56**, 502-508 (1986).
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- Wagner, H. D., Schwartz, P., and Phoenix, S. L., Lifetime Statistics for Single Kevlar 49 Filaments in Creep-Rupture. *J. Mater. Sci.*, **21**, 1868-1878 (1986).
- Schwartz, P., Rosensaft, M., and Wagner, H. D., The Effects of Filament Diameter Variability on the Failure of Kevlar 49/Epoxy Strands. *J. Mater. Sci. Lett.*, **4**, 1409-1412 (1985).
- Mooney, C. L. and Schwartz, P., The Effect of Salt Spray on the Rate of Water Vapor Transmission in Microporous Fabrics. *Text. Res. J.*, **55**, 449-452 (1985).
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- Schwartz, P., Complex Triaxial Fabrics: Cover, Flexural Rigidity, and Tear Strength. *Text. Res. J.*, **54**, 581-584 (1984).
- Schwartz, P., A Mathematical Analysis of a Fabric Having Nonorthogonal Interlacings Using Strain Energy Methods. *Fibre Sci. Technol.*, **20**, 273-282 (1984).
- Schwartz, P., The Effect of Jamming on Seam Pucker in Plain Woven Fabrics. *Text. Res. J.*, **54**, 32-34 (1984).
- Schwartz, P., Bending Properties of Triaxially Woven Fabrics. *Text. Res. J.*, **52**, 604-606 (1982).
- Schwartz, P., Fornes, R., and Mohamed, M., An Analysis of the Mechanical Behavior of Triaxial Fabrics and the Equivalency of Conventional Fabrics. *Text. Res. J.*, **52**, 388-394 (1982).
- Schwartz, P., Fornes, R. E., and Mohamed, M. H., Tensile Properties of Triaxial Fabrics Under Biaxial Loading. *Trans. of ASME, J. Engr. Industry*, **102**, 327-332 (1980).

#### *PATENTS*

- Hoffmann, M., Baird, and Schwartz, P., Non-woven Fiber Barriers for Control of Agricultural Pests, U. S. Patent 6054923, 25 April 2000.

#### *BOOK*

- Schwartz, P., Rhodes, T. and Mohamed, M., *Fabric Forming Systems*. Park Ridge, NJ: Noyes Publications, 1982.

#### *BOOK CHAPTERS, ENCYCLOPEDIA ENTRIES*

- Schwartz, P., "Measuring Interface Strength in Composite Materials." *Surface Characteristics of Fibers and Textiles: Part III*, C. Pastore, ed. Marcel Dekker: New York, 219-233, 2001.

- Bunsell, A. R. and Schwartz, P., "Fibre Test Methods." *Comprehensive Composite Materials*, v.5, L. Carlsson, R. L. Crane, and K. Uchio, v. eds., A. Kelley and C. Zweben, eds. Elsevier: Oxford 49-70, 2000.
- Schwartz, P., "Textile Product Flammability." *Encyclopedia of the Consumer Movement*, S. Brobeck, ed. ABC-CLIO: Santa Barbara, CA, 562-563, 1997.
- Schwartz, P., Rhodes, T. and Mohamed, M. H., "Textiles, Woven." *Encyclopedia of Chemical Processing and Design*, v.57, J. J. McKetta and G. E. Weismantel, eds. Marcel Dekker: New York, 186-214, 1996.
- Schwartz, P., Stumpf, H. and Lienkamp, M., "Monte Carlo Simulations of the Strength and Stress-Rupture of Seven-Fiber Graphite/Epoxy Composites." *Computational Stochastic Mechanics: Theory, Computational Methodology, and Application*, A. H-D. Chung, C. Y. Yang, eds. Computational Mechanics Publications: Southampton/Elsevier Applied Science: London, 395-424, 1993.
- Schwartz, P., "Statistics for the Short Term Strength and Creep Rupture of Para-Aramid Fibers." *Polymer and Fiber Science: Recent Advances*, R. E. Fornes, R. D. Gilbert, eds., H. Mark, hon. ed. VCH Publishers: New York, 77-82, 1991.
- Schwartz, P., "Creep Rupture." *Encyclopedia of Composites*, v.1, Stuart M. Lee, ed. VCH Publishers: New York, 521-531, 1989.

#### GRADUATE THESES SUPERVISED

- Ünsal, E., *Numerical Modeling of Flow Through Porous Media*, Ph.D. (Integrated Textile and Apparel Science), 2003.
- Mittal, J., *Using Renormalization to Model the Strength of Carbon Fiber Epoxy Strands*, M.S. (Fiber Science), 2000.
- Lin, C.-y., *Design and Construction of a Device for Electro-spinning Polymer Fibers*, M.Eng. (Mechanical Engineering), 2000.
- Luellen, J., *Materials Handling*, M.Eng. (Mechanical Engineering), 2000.
- Chen, Z., *Electrostatic Spinning of Fibers from the Melt*, M.S. (Fiber Science), 2000.
- Weber, I., *Monitoring the Bending Fatigue of Carbon Fiber Reinforced Epoxy Composite Strands using Resistance Techniques*, M.Eng. (Mechanical Engineering), 1999.
- Couillard, R. A. A., *Production and Analysis of Extremely Fine Polymeric Fibers Created by the Application of an Electrostatic Field*, Ph.D. (Fiber Science), 1998.
- Miller, A. M., *Liquid Penetration of Barrier Materials*, Ph.D. (Fiber Science), 1998.
- Köster, K. F., *Torsional Fatigue of Carbon Fiber Reinforced Epoxy Composite Strands and the Influence of Plasma Treatment on the Fatigue Behavior*, M.Eng. (Mechanical Engineering), 1998.

- Feih, S., *Influence of Plasma Treatment with Acetylene and Oxygen at Different Ratios and Treatment Times on the Chemical Properties of the Carbon Fiber Surface and the Shear Strength of a Carbon Fiber/Epoxy Interface*, M.Eng. (Mechanical Engineering), 1995.
- Miller, A. M., *Effect of Aging on Interface Strength in Plasma Treated Polyethylene Fiber Reinforced Composites*, M.S. (Fiber Science), 1996.
- Kazanci, M., *Creep-Rupture Lifetime of Composites as a Function of Matrix Stiffness*, M.S. (Fiber Science), 1995.
- Couillard, R. A. A., *Bending Fatigue of Carbon Fiber Reinforced Epoxy Composite Strands*, M.S. (Fiber Science), 1995.
- Straub, A., *Prediction of the Thermo-Viscoelastic Behavior in a Kevlar/Epoxy Composite using the Microbond Test under Different Temperatures and Strain Rates*, M.Eng. (Mechanical Engineering), 1995.
- Bentley, M. A., *Quality Function Deployment: A Computer Program to Develop a Quality Function Deployment Chart for Engineering Projects*, M.Eng. (Mechanical Engineering), 1994.
- Rehm, W., *Analysis of the Surface of Aramid Fibers After Gas Plasma Treatment and Plasma Polymerization using Environmental Scanning Electron Microscopy and Fourier Transform Infrared Spectroscopy*, M.Eng. (Mechanical Engineering), 1993.
- Knickrehm, A., *Measurement of Bonding Properties in a Kevlar/Epoxy Composite after Fiber Surface Modification with Plasma Treatment*, M.Eng. (Mechanical Engineering), 1993.
- Stumpf, H., *Stochastic Modeling of the Creep-Rupture of a 7-fiber Hybrid Composite*, M.Eng. (Mechanical Engineering), 1992.
- Qiu, Y., *A Stochastic Model for the Strength and Creep Lifetime of Hybrid Composites*, Ph.D. (Fiber Science), 1992.
- Lienkamp, M., *Stochastic Modeling of the Strength of a 7-Fiber Hybrid Composite*, M.Eng. (Mechanical Engineering), 1991.
- Heirigs, L. M., *Fatigue of Nylon and Polyester Sheathed Aramid Double Braids*, M.S. (Fiber Science), 1991.
- Hild, D. N., *Toughening of Acrylic Bone Cements using Gas Plasma Treated Polyethylene Fibers*, Ph.D. (Fiber Science), 1991.
- Toney, M. M., *Bending and Torsional Fatigue of Nylon 66 Monofilaments*, Ph.D. (Fiber Science), 1991.
- Küpper, K. F., *Modification of Fiber/Matrix Interface of p-Aramid Fibers using Gas Plasma*, M.Eng. (Mechanical Engineering), 1990.
- Sembach, S. A., *Ammonia Plasma Treatment of Ultra High Strength Polyethylene Fabric*, M.S. (Fiber Science), 1988.

Shahpurwala, A. A., *The Use of Statistical Methods to Understand and Predict the Tensile Failure of Woven Fabrics*, M. S. (Fiber Science), 1987.

Sampathkumar, V., *Effect of Sea Water Immersion on the Tensile Strength of Aramid Braids*, M.S. (Fiber Science), 1987.

Robinson, H. H., IV, *Elements on the Strength and Creep-Rupture of Carbon/Epoxy Microcomposites*, M.S. (Mechanical Engineering), 1987.

Mandaiker, S. V., *Mechanical Behaviour of Small Diameter Aramid Braids*, M.S. (Fiber Science), 1985.

Mooney, C. L., *An Analysis of the Physical Properties of Two Microporous Fabrics in Relation to Current and Future End Use*, M.S. (Fiber Science), 1984.

#### *PROFESSIONAL AFFILIATIONS*

American Chemical Society

American Society for Engineering Education

American Society of Mechanical Engineers

Company of Military Historians

Fiber Society

- Governing Council 1988-91, Vice-President, 1994, President, 1995

Materials Research Society

Society for the Advancement of Materials Processing and Engineering