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**FLUIDS, LUBRICANTS, AND
LUBRICATION TECHNOLOGY**

Work Unit Directive (WUD) 51

Dr. Jeffrey S. Zabinski



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14. ABSTRACT This final report is a bibliography of technical journal articles, presentations, patents, and reports generated by members of AFRL/MLBT and collaborators. The work was accomplished at Wright-Patterson AFB over a period of 10 years and covers such areas as fluids, lubricants, and lubrication technology.					
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FOREWORD

The following is a compilation of technical journal articles, presentations, patents, and reports generated by members of AFRL/MLBT and collaborators for the period 1985-1995.

A handwritten signature in black ink, reading "Jeffrey S. Zabinski". The signature is written in a cursive style with a large initial "J" and "Z".

JEFFREY S. ZABINSKI, Chief
Nonstructural Materials Branch
Nonmetallic Materials Division

1985

PUBLICATIONS, PRESENTATIONS, PATENTS, TR'S

"Liquid Lubricants for Use at High Temperatures", American Society of Lubrication Engineers Special Publication SP-15 (1984).

"Fluoro-ketones VI. Synthesis of Perfluoro Di- and Tetra-Ketones from 1,1-Dichlorobenzyl-lithium and Perfluoroesters", Journal of Fluorine Chemistry, 26, 269 (1984).

"Fluoro-ketones VII. Synthesis of Perfluoro Mono- and Di-Ketones from Perfluoro-Grignard or Lithium Reagents and Diethylcarbamate and Diethyl Oxalate", Journal of Fluorine Chemistry, 26, 341 (1984).

"Reactions of 1,2-Bis(Trifluoroacetyl)Benzene with Nucleophiles Leading to Heterocyclic Compounds", Journal of Fluorine Chemistry, 28, 139 (1985).

"Nonflammable Hydraulic Fluid System Development for Aerospace", J. of Syn. Lubr. 1, 188 (1984).

"Military Lubricants for Aircraft Turbine Engines", presented at the 60th Meeting of the Structures and Materials Panel, AGARD, NATO and published as proceedings (1985).

"Development of a -54°C to 135°C Synthetic Hydrocarbon-based, Fire-Resistant Hydraulic Fluid", presented at the 40th Annual ASLE Meeting, Las Vegas, Nevada (1985).

"Performance Modeling - A Tool for Lubricant Development", presented at the 60th Meeting of the Structures and Materials Panel, AGARD, NATO and published as proceedings (1985).

"Performance Simulation of a Solid-Lubricated Ball Bearing", presented at the ASLE National Meeting, Las Vegas, NV, 7 May 1985.

1986

PUBLICATIONS, PRESENTATIONS, PATENTS, TR'S

- "A New General Synthesis Route to 1,1,1-Trihalopolyfluoroalkanes", Journal of Fluorine Chemistry, 31, 405 (1986).
- "Air Force Nonflammable Hydraulic System Materials Development", presented at the SAE Aerospace Technology Conference, Long Beach, CA, October 1985 and published as proceedings.
- "Advanced Lubricants for Aircraft Turbine Engines", presented at the SAE Aerospace Technology Conference, Long Beach, CA, October 1985 and published as proceedings.
- "Military Aircraft 4 cSt Gas Turbine Engine Oil Development", presented at the ASLE Annual Meeting, Toronto, Canada, 15 May 1986, and accepted for publication in Lubrication Engineering.
- "Fluoro-ketones VIII. Synthesis of Some Fluoroquinoxaline Compounds from Fluoroketones", Journal of Fluorine Chemistry, 30, 385 (1986).
- "Aircraft Gear and Bearing Tribological Systems", presented at AGARD Conference No. 394, NATO, October 1985 and published as proceedings.
- "Synthesis and Reactions of a Perfluoroalkylether Organometallic Compound Containing a Functional Ester Group", presented at the Dayton Section, American Chemical Society Meeting, University of Dayton, March 1986.
- "Synthesis and Reactions of a Perfluoroalkylether Grignard Reagent Containing a Functional Ester Group", accepted for publication in Journal of Fluorine Chemistry (1986).
- "Development of a Low-Temperature MIL-H-83282 Hydraulic Fluid", presented at SAE Aerospace Fluid Power Committee Meeting, San Diego, CA, October 1985.
- "Thermal Decomposition Investigations of Candidate High-Temperature Base Fluids; I. Silahydrocarbons", presented at the 41st ASLE National Meeting, Toronto, Ontario, Canada, May 1986 and accepted for publication in ASLE Transactions.
- "Synthesis and Reactions of Some Perfluoroalkylether-Substituted Silanes", Journal of Organometallic Chemistry, 293, 313 (1985).
- "Fluoroketones IX. Hydration of Perfluoroalkylpolyketones and Their Reactions Forming Novel Cyclic Compounds", Journal of Fluorine Chemistry, 31, 381 (1986).

1987

PUBLICATIONS, PRESENTATIONS, PATENTS, TR'S

"Chlorotrifluoroethylene Oligomer Technology - Synthesis, Characterization and Properties of Oligomers", presented at the 8th Winter Fluorine Conference, St. Petersburg, FL, 28 January 1987.

"Reaction of Phosphorus Pentachloride with Perhalocarbonyl-Containing Compound", presented at the 194th National Meeting of the American Chemical Society, New Orleans, LA, 1 September 1987.

"Pump Evaluation of Hydrogenated Polyalphaolefin Candidates for a -54° to 135°C Fire-Resistant Air Force Aircraft Hydraulic Fluid", presented at the STLE Annual Meeting, Anaheim, CA, May 1987; accepted for publication in Lubrication Engineering.

"Hydrolytic Studies of Some Silicon Based High Temperature Fluids", presented at the STLE Annual Meeting, Anaheim, CA, May 1987; submitted for publication in Lubrication Engineering.

"The Significance of Various By-Products of Different Proposed Synthesis Routes of Silahydrocarbon Fluids on Their Physical and Chemical Properties", presented at the STLE Annual Meeting, Anaheim, CA, May 1987; submitted for publication in Lubrication Engineering.

"Military Aircraft 4 cSt Gas Turbine Engine Oil Development", Lubrication Engineering, 43, 8, 654-659 August 1987.

"Solvent Effects in Reactions Between Perfluoroalkyliodides and Cadmium", Journal of Fluorine Chemistry, 36, 123-139 (1987).

"Reaction of 1,2-Dichloriodotrifluoroethane With Zinc", Journal of Fluorine Chemistry, 35, 421-424 (1987).

"Regiospecific Synthesis of Aromatic Compounds Via Organometallic Intermediates. Part 5. Substituted Perfluoroalkylether Benzenes", Journal of Fluorine Chemistry, 35, 571-580 (1987).

"Synthesis and Reactions of a Perfluoroalkylether Grignard Reagent Containing a Functional Ester Group", Journal of Fluorine Chemistry, 34, 299-311 (1987).

"Modification of Lubricant Traction Measuring Device", AFWAL-TR-86-4031, January, 1987.

"Traction Behavior of Some Lubricants and Hydraulic Fluids", Transactions of ASME, Journal of Tribology, 1099, #2, 372-373 (1987).

1988

PUBLICATIONS, PRESENTATIONS, PATENTS, TR'S

"Free-Radical Catalyzed Addition of Carbon Tetrachloride to Fluoro Olefins", presented at the 12th International Symposium on Fluorine Chemistry, Santa Cruz, CA, 9 August 1988.

"Chlorofluorocarbon Model Compounds and Fluids. Part I. Synthesis", presented at the 12th International Symposium on Fluorine Chemistry, Santa Cruz, CA, 11 August 1988.

"Synthesis and Reactions of a Perfluoroalkylether Grignard Reagent Containing a Functional Ester Group", J. Fluorine Chemistry 34, 299 (1987).

"Polyfluoroalkylation of Bromoaromatic Compounds Via Perfluoroalkylcopper Intermediates", presented at the 12th International Symposium on Fluorine Chemistry, Santa Cruz, CA, 9 August 1988.

"Thermal Decomposition Investigations of Candidate High Temperature Base Fluids: II. Silahydrocarbons", presented at the STLE Annual Meeting, Cleveland, OH, 11 May 1988.

"A Systematic Study of the Oxidative Stability of Silahydrocarbons by Pressure Differential Scanning Calorimetry", presented at the STLE Annual Meeting, Cleveland, OH, 10 May 1988.

"Determination of the Relative Thermo-Oxidative Stability of Deuterated Lubricants Using Differential Scanning Calorimetry", presented at the STLE Annual Meeting, Cleveland, OH, 10 May 1988.

"Dynamic Oxygen Absorption of Model Silahydrocarbon Fluids at Elevated Temperatures", presented at the STLE Annual Meeting, Cleveland, OH, 10 May 1988.

"Pump Evaluation of Hydrogenated Polyalphaolefin Candidates for a -54° to 135°C Fire-Resistant Air Force Aircraft Hydraulic Fluid", Lubrication Engineering, 44, 324 (1988).

"Chlorofluorocarbon Model Compounds and Fluids, Part 2. Molecular Structure-Property Relationships", presented at the 12th International Symposium on Fluorine Chemistry, Santa Cruz, CA, 11 August 1988.

"Advanced Hydraulic Fluids for Future Aerospace Applications", presented at S.A.E. Aerotech 88 Exposition and Symposium, Anaheim, CA, 5 October 1988.

"High-Temperature Liquid Lubricant Research", presented at the 1988 Gordon Research Conference on Tribology, Holderness School, Plymouth, NH, 22 June 1988.

"Air Force Tribology Programs", presented at the International Conference on Engineered Materials for Advanced Friction and Wear Applications", Gaithersburg, MD, March 1988. Published as Symposium Proceedings, pp 187-190, ASM International (1988).

"Chemical and Physical Properties of Perfluoropolyalkylether Fluids", presented at the High Temperature Advanced Gas Turbine Engine Liquid Lubricants and Seals for IHPTET Workshop, Dayton, OH, 23 August 1988.

"Base Fluid and Additive Technology", presented at the High Temperature Advanced Gas Turbine Engine Liquid Lubricants and Seals for IHPTET Workshop, Dayton, OH, 24 August 1988.

"Planned High Temperature Liquid Lubricants Research Program and the Materials Laboratory In-House Role", presented at the High Temperature Advanced Gas Turbine Engine Liquid Lubricants and Seals for IHPTET Workshop, Dayton, OH, 24 August 1988.

"Structure-Property/Activity Relationships", presented at the High Temperature Advanced Gas Turbine Engine Liquid Lubricants and Seals for IHPTET Workshop, Dayton, OH, 24 August 1988.

"Molecular Modeling", presented at the High Temperature Advanced Gas Turbine Engine Liquid Lubricants and Seals for IHPTET Workshop, Dayton, OH, 24 August 1988.

"Tribological Modeling/Behavior", presented at the High Temperature Advanced Gas Turbine Engine Liquid Lubricants and Seals for IHPTET Workshop, Dayton, OH, 24 August 1988.

"Surface Chemistry", presented at the High Temperature Advanced Gas Turbine Engine Liquid Lubricants and Seals for IHPTET Workshop, Dayton, OH, 24 August 1988.

"State of the Art of High Temperature Seal Technology", presented at the High Temperature Advanced Gas Turbine Engine Liquid Lubricants and Seals for IHPTET Workshop, Dayton, OH, 23 August 1988.

"High Temperature Seal Program", presented at the High Temperature Advanced Gas Turbine Engine Liquid Lubricants and Seals for IHPTET Workshop, Dayton, OH, 24 August 1988.

1989

PUBLICATIONS, PRESENTATIONS, PATENTS, TR'S

"Synthesis of 1,3,5-Tri-n-alkylbenzene Compounds", J. of Organic Chemistry 53, 5564 (1988).

"Zinc Coupling Reactions of 1,2 and 2,2-Dichloriodotrifluoroethane", presented at the 9th Winter Fluorine Conference, St. Petersburg, FL, 3 February 1989.

"Reactions of Phosphorus Pentachloride with Perhalo Carbonyl-containing Compounds, J. of Fluorine Chemistry, 43, 371 (1989).

"Polyfluoroalkylation of Bromoaromatic Compounds via Perfluoroalkyl Copper Intermediates", J. of Fluorine Chemistry 43, 207 (1989).

"Perfluoropolyalkylether Liquid Lubricant Technology", presented at the 9th Winter Fluorine Conference, St. Petersburg, FL, 31 January 1989.

"Alkyl Benzenes - Candidate High-Temperature Hydraulic Fluids", presented at the 44th Annual STLE Meeting, Atlanta, GA, May 1989.

"Thermal Stability Characteristics of a Nonflammable Chlorotrifluoroethylene CTFE Base Stock Fluid", presented at the 44th Annual STLE Meeting, Atlanta, GA, May 1989.

"Correlation of Viscosity-Temperature Properties of Chlorofluorocarbons with Molecular Structure", presented at the 44th Annual STLE Meeting, Atlanta, GA, May 1989.

"Dynamic Seals for Advanced Hydraulic and Lubricating Oil Systems", presented at the Society of Automotive Engineers A-6C Committee Meeting, Phoenix, AZ, 12 October 1989.

"Compounding and Testing Static and Dynamic O-ring Seals for CTFE", presented at the Society of Automotive Engineers G-4 Committee Meeting, Williamsburg, VA, 1 May 1989.

"Dynamic and Static Seals for CTFE", presented at the Society of Automotive Engineers A-6C Committee Meeting, Dallas, TX, 4 October 1989.

"High-Temperature Liquid Lubricant Research", presented at the NASA Lewis Research Center, Cleveland, OH, 26 September 1989.

1990

PUBLICATIONS, PRESENTATIONS, PATENTS, TR'S

"Polyfluoroalkylation of Bromoheterocyclic Compounds Via Perfluoroalkylcopper Intermediates", J. of Fluorine Chemistry 46, 137 (1990).

"Free-Radical Initiated Addition of Carbon Tetrachloride To Fluoro Olefins", J. of Fluorine Chemistry 47, 261 (1990).

"Perfluoroalkyl and Perfluoroalkylether Chlorosulfates in the Synthesis of Substituted Benzazoles", J. of Fluorine Chemistry 49, 197 (1990).

"Reaction of 2,2-Dichlorotrifluoro-1-iodoethane With Zinc", J. of Fluorine Chemistry 48, 17 (1990).

"High Temperature Hydraulic Fluids for Advanced Aerospace Applications", presented at the 45th Annual STLE Meeting, Denver, CO, May 1990.

"Research and Development of Low Volatility Silahydrocarbon Based Liquid Lubricants for Space", presented at the 45th Annual STLE Meeting, Denver, CO, May 1990.

"Lubrication Characteristics of Some Space Fluids", presented at the 45th Annual STLE Meeting, Denver, CO, May 1990.

"Synthesis and Characterization of a High Temperature, Low Volatility Phosphate Additive for Aerospace Applications", presented at the 45th Annual STLE Meeting, Denver, CO, May 1990.

"Interaction of Metals With Chlorotrifluoroethylene Fluid at Elevated Temperatures", presented at the 45th Annual STLE Meeting, Denver, CO, May 1990.

"Interaction of Alloys with Chlorotrifluoroethylene Fluid at 177°C.", presented at the 45th Annual STLE Meeting, Denver, CO, May 1990.

"Perfluoropolyalkylethers - Liquid Lubricants of the Future?", presented at the Industrial Tribology Conference, Northwestern University, Evanston, IL, August 1990.

"Thermal Decomposition Investigations of Candidate High Temperature Base Fluids II. Silahydrocarbons", Tribology Transactions 32, 141 (1989).

"A Systematic Study of the Oxidative Stability of Silahydrocarbons by Pressure Differential Scanning Calorimetry", Lubrication Engineering 46, 263 (1990).

Note: All publications listed are in refereed journals.

"Dynamic Oxygen Absorption of Model Silahydrocarbon Fluids at Elevated Temperatures", Lubrication Engineering 46, 97 (1990).

"Alkyl Benzenes - Candidate High Temperature Hydraulic Fluids", Lubrication Engineering 46, 377 (1990).

"Thermal Stability Characteristics of a Nonflammable Chlorotrifluoroethylene CTFE Base Stock Fluid", Lubrication Engineering 46, 601 (1990).

"Development of a Soluble Lubricity Additive for Perfluoropolyalkylether Fluids", J. of Synthetic Lubrication 7, 15 (1990).

"Molecular Modeling Studies of Model Compounds and Additives", presented at the Air Force Computational Chemistry Coordination Meeting, Kirtland AFB, NM, 23 May 1990.

"Crystallization of Molybdenum Disulfide Films Deposited by Pulsed Laser Ablation", presented at the Fall Meeting of the Materials Research Society, Boston, MA, 25 November 1990.

"Pulsed Laser Deposition of Metal Dichalcogenides on Stainless Steel", presented at the Fall Meeting of the Materials Research Society, Boston, MA, 25 November 1990.

"Wear of Ceramics", Concise Encyclopedia of Advanced Ceramic Materials", pp 511-515, Pergamon Press, Oxford (1990).

"Fluid Aging and Compatibility of Elastomers in CTFE", presented at the SAE G-4 Meeting, San Diego, CA, 15 Oct 1990.

"Effect of Viscosity Index Improvers on Elastohydrodynamic Lubrication Characteristics of a Chlorotrifluoroethylene and a Polyalphaolefin Fluid", presented at the 45th Annual STLE Meeting, Denver, CO, May 1990.

"Polysilahydrocarbon Synthetic Fluids. 1. Synthesis and Characterization of Trisilahydrocarbons", Ind. Eng. Chem. Res. 29, 1855 (1990).

"Pulsed Laser Deposition of Tribomaterials", presented at the Air Force Tribology Technical Review, Fairborn, OH, November 1989.

"Laser Raman Spectroscopy of Tribomaterials", presented at the Air Force Tribology Technical Review, Fairborn, OH, November 1989.

"Future ML Tribology Capabilities/Studies", presented at the Air Force Tribology Technical Review, Fairborn, OH, November 1989.

"Pulsed Laser Deposition of Metal Dichalcogenides", presented at the Air Force Molecular Dynamics Contractors Conference, Captiva Island, FL, October 1989.

"Traction Behavior of Some Space Lubricants", presented at the Air Force Tribology Technical Review, Fairborn, OH, November 1989.

Note: All publications listed are in refereed journals

1991

PUBLICATIONS, PRESENTATIONS, PATENTS, TR'S

"Hydrolytic Studies of Some Silicon Based High Temperature Fluids", Lubrication Engineering, 46, 706 (1990).

"Correlation of Viscosity-Temperature Properties of Chlorofluoro-Carbons with Molecular Structure", Lubrication Engineering 47, 485 (1991).

"Synthesis and Characterization of a High-Temperature, Low-Volatility Phosphate Additive for Aerospace Applications", Lubrication Engineering 47, 935 (1991).

"Formation and Reactions of Carbanions from Alpha-Substituted Secondary Perfluoroacyl Fluorides", presented at the 10th Winter Fluorine Conference, St. Petersburg, FL, 1 Feb 1991.

"The Copper Coupling Reactions of Chlorofluoro Compounds", presented at the 10th Winter Fluorine Conference, St. Petersburg, FL, 31 Jan 1991.

"Lubricity Additive for Perfluoropolyalkylether Fluids", AF Invention No. 19850.

"Lubricity Additive for Polyphenylethers", AF Invention No. 19880.

"High Temperature Nonflammable Hydraulic Fluid Formulation Composition", AF Invention No. 19919.

"Interaction of Metals with Chlorotrifluoroethylene Fluid at Elevated Temperatures", Lubrication Engineering 47, 816 (1991).

"Tribology of Metal Matrix Composites: Formation and Attrition of Third-Body Films", Proceedings of the XVIIIth Leeds-Lyon Symposium on Wear Particles: From the Cradle to the Grave, 3-6 Sep 1991, Lyon, France.

"Tribology of Aluminum Metal-Matrix Composites: Lubrication by Graphite", Proceedings of the International Conference on Wear of Materials, Orlando, FL, pp. 149-157, April 1991.

"Composites for Friction and Wear Applications", in Concise Encyclopedia of Composite materials, pp 106-111 (1990).

"Composites Based on Natural Fibers", in Concise Encyclopedia of Composite Materials, pp 197-199 (1990).

"Wear of Ceramics", in Concise Encyclopedia of Advanced Ceramic Materials, pp. 511-515, Pergamon Press, (1991).

"Development of a -54°C to 175°C High Temperature Nonflammable Hydraulic Fluid, MIL-H-53119, for Air Force Systems", presented at the 46th Annual STLE Meeting, Montreal, Canada, May 1991.

Development of a Moisture Resistant, High Load Carrying Polyalphaolefin Based Grease", presented at the 46th Annual STLE meeting, Montreal, Canada, May 1991.

"Polyalphaolefin Coolant Development", presented at the Workshop on PAO Coolant Conversion, Dayton, OH, July 1991.

"Perfluoropolyalkylethers. Liquid Lubricants of the Future", presented at International Tribology Symposium, Northwestern University, August 1990.

"Advances in Engineering Tribology", Book Chapter, published by Society of Tribologists and Lubrication Engineers, Chicago, IL, (1991).

"Crystallization of Molybdenum Disulfide Films Deposited by Pulsed Laser Ablation", Mat. Res. Soc. Symp. Proc., 201, 195 (1991).

"Method for Forming Thin Solid Lubricious Films and Film Articles Made Thereby", U.S. Patent 5,002,798, 26 Mar 1991.

"Pulsed Laser Deposition of Metal Dichalcogenides on Stainless Steel", Mat. Res. Soc. Symp. Proc. 201, 117 (1991).

"350°F CTFE Fluid Evaluation in Aircraft Hydraulic Pump", presented at SAE Committee A-6 Meeting, Atlanta, GA, May 1991.

"Comparison of Seal Life for Various Dynamic Tests", presented at SAE A6-C Meeting, Atlanta, GA, May 1991

"Effect of ASTM Test Method on Fluorosilicone Compression Set", presented at the SAE EC Meeting, Sacramento, CA, October 1991.

"Seal Formulation, Compatibility and Dynamic Performance in the Chlorotrifluoroethylene (CTFE) Nonflammable Hydraulic Fluid. Volume 1: Formulation of Elastomers for Use in CTFE", WL-TR-91-4046, July 1991.

1992

PUBLICATIONS, PRESENTATIONS, PATENTS, TR'S

"Research and Development of Low Volatility Silahydrocarbon Based Liquid Lubricants for Space", Lubrication Engineering, 48, 325 (1992).

"Synthesis and Characterization of a High Temperature, Low Volatility Phosphate Additive for Aerospace Applications", Lubrication Engineering, 47, 935 (1991).

"High Temperature Hydraulic Fluids", published in Esslingen 2000 Tribology Conference Proceedings, and J of Synthetic Lubrication, 2, 115 (1992).

"Cross-coupling Reactions of Perfluoroalkyl and Perfluoroalkylether Iodides with Haloaromatic Compounds in the Presence of Copper", presented at the 203rd National Meeting of the American Chemical Society, San Francisco, CA, April 1992.

"Fluorinated Polyether Lubricant Compositions", Invention Disclosure #135, 8 July 1992.

"Perfluoro Tertiary Alcohols I. Synthesis of High Molecular Weight Perfluorinated Mono Ketones and Tertiary Alcohols", J of Fluorine Chemistry, 55, 119 (1991).

"Perfluoro Tertiary Alcohols II. Synthesis of High Molecular Weight Perfluorinated Diketones, Keto Alcohols and Tertiary Dialcohols", J of Fluorine Chemistry, 59, 113 (1992).

"Formation and Reactions of Carbanions from α -Substituted Perfluoroacyl Fluorides", J of Fluorine Chemistry, 55, 93 (1991).

"PAO Coolant Conversion Workshop Proceedings", WL-TR-91-4108 (1991).

"High Temperature (175°C) Nonflammable Hydraulic Fluid Formulation Composition", US Patent 07/882,339 13 May 1992.

"Polyalphaolefin Coolant Development and Transition", Invited Presentation at SAE Committee A6-9 and AC-9C, Aircraft Environmental Systems, Orlando, FL, Oct 1991.

"Chlorotrifluoroethylene Oligomer Based Nonflammable Hydraulic Fluid. I. Fluid, Additive and Elastomer Development", presented at the Esslingen Tribology 2000 Conference, Esslingen, Germany, Jan 1992.

"High Temperature Hydraulic Fluids", presented at the Esslingen Tribology 2000 Conference, Esslingen, Germany, Jan 1992.

"Structure/Property Relationships of Model Chlorotrifluoroethylene Oligomer Model Compounds: Thermal Stability", presented at the 47th Annual STLE Meeting, Philadelphia, PA, May 1992.

"Soluble Additives for Perfluoropolyalkylether Liquid Lubricants", presented at the 47th Annual STLE Meeting, Philadelphia, PA, May 1992.

"Fire Resistant Hydraulic Fluids", presented at the Society of Automotive Engineers' Aerotech '92, Anaheim, CA, Oct 1992.

"Nonflammable Hydraulic Fluids/Seals", presented at Society of Automotive Engineers' Aerotech '92, Anaheim, CA, Oct 1992.

"Synthetic Lubricants and High-Performance Functional Fluids", Book Chapter, *Aerospace*, published by Marcel Dekker, Inc. New York, NY (1992).

"*Ab Initio* Study of Conformational Energies and Rotational Barriers in a Chlorofluoroethane", *J. Physical Chemistry*, 96, 1702 (1992).

"Fluoride Formation at the PFAE/Metal Interface", presented at AFOSR Molecular Dynamics Contractor's Conference, Irvine, CA, Oct 1991.

"Interaction of Alloys with Chlorotrifluoroethylene Fluid at 177°C", *Lubrication Engineering*, 47, 1028 (1991).

"Growth of TiO₂ Thin Films by Pulsed Laser Evaporation", *Mat. Res. Soc. Symp. Proc.* 191, p 43 (1991).

"Pulsed Laser Deposition of Tribological Materials", *Lectures Notes in Physics*, 389, Springer-Verlag, New York, NY p. 271 (1991).

"Chemical Reactivity at Buried Interfaces I. Iron on Stoichiometric Molybdenite", *Surface Science*, 241, 157 (1991).

"Chemical Reactivity at Buried Interfaces II. Iron on Nonstoichiometric Molybdenite", *Surface Science*, 241, 170 (1991).

"Tribology of Metal Matrix Composites: Formation and Attrition of Third-Body Films", Chapter in *Wear Particles: From Cradle to the Grave*", Elsevier, p. 121 (1992).

"Tribology of Aluminum Metal-Matrix Composites: Lubrication by Graphite", *Wear*, 149, 241 (1991).

"Chemical and Tribological Characteristics of MoS₂-PbO Films Deposited by Pulsed Laser Deposition", *Thin Solid Films*, 214, 156 (1992).

"Low Temperature Synthesis of Carbide Thin Films by Pulsed Laser Deposition (PLD)", in *Photons and Low Energy Particles in Surface Processing*", Materials Research Society Symposium Proceedings, 236, 461 (1992).

"Synthesis and Tribochemistry of PbO Films Grown by Pulsed Laser Deposition", in *Photons and Low Energy Particles in Surface Processing*, Materials Research Society Symposium Proceedings, 236, 437 (1992).

"Pulsed Laser Deposition of Tungsten Disulphide (WS_2) Films on Aluminum Metal-Matrix Composite Substrates", presented at the Fall Meeting of the Materials Research Society, Dec 1991.

"The Chemical and Tribological Properties of Laser Deposited Niobium Dichalcogenides", presented at the Fall Meeting of the Materials Research Society, Dec 1991.

"Synthesis and Tribochemistry of PbO and $PbMoO_4$ Films Grown by Pulsed Laser Deposition", presented at the Fall Meeting of the Materials Research Society, Dec 1991.

"Synthesis and Characterization of B_4C Thin Films Grown by Pulsed Laser Deposition", presented at the Fall Meeting of the Materials Research Society, Dec 1991.

"Tribology Research Program - Overview", presented at the Dept. of Mechanical Engineering, Ohio State University, Columbus, OH, March 1992.

"Tribological Behavior of TiC Thin Films Grown by Pulsed Laser Deposition", presented at the ICMCTF Meeting, April 1992.

"Interface Study of a Mixture Sb_2O_3 and MoS_2 using Raman Spectroscopy", presented at the ICMCTF Meeting, April 1992.

"Growth and Characterization of $C:N$ Thin Films", presented at the ICMCTF Meeting, April 1992.

"Investigations of tribological Materials using Raman Spectroscopy", presented at the ICMCTF Meeting, April 1992.

"Friction and Wear of PbO Films Grown by PLD", presented at the ICMCTF Meeting, April 1992.

"Characterization of Pulsed Laser Deposited PbO/MoS_2 Thin Films by Transmission Electron Spectroscopy", presented at the ICMCTF Meeting, April 1992.

"Characterization of Pulsed Laser Deposited MoS_2 Thin Films by Transmission Electron Microscopy", presented at the ICMCTF Meeting, April 1992.

"Charge Referencing in the XPS Analysis of Nonconducting Thin Films", presented at the ICMCTF Meeting, April 1992.

"Low Temperature Synthesis of Carbide Coatings by Pulsed Laser Deposition (PLD)", presented at the ICMCTF Meeting, April 1992.

"Aluminum Metal-Matrix Composites Tailored for Antifriction Applications", presented at the ICMCTF Meeting, April 1992.

"Tribomaterials for Extreme Environments", presented at the Dayton Section STLE Meeting, Dayton, OH, Sept 1992.

"Laser Processing of Tribomaterials for Extreme Environments", presented at the AIChE Meeting, Dayton, OH Sept 1992.

"PLD of Niobium Diselenide Thin Films", presented at U.S. Army Materials Technology Laboratory, Watertown, MA, Sept 1992.

"Utilizing Raman Spectroscopy in Thin Film Tribochemistry Studies", invited presentation at the Gordon Research Conference on Tribology, Plymouth, NH, June 1992.

"Laser Processing of Tribomaterials for Extreme Environments", invited presentation at the Gordon Research Conference on Particle-Solids Interactions, Plymouth, NH, July 1992.

"Laser Processing of Tribomaterials - Overview", presented at the AFOSR Molecular Dynamics Contractors' Conference, Newport Beach, CA, October 1992.

"Method for Forming Thin Solid Lubricious Films and Film Articles Made Thereby", U. S. Patent 5,002,798 (26 Mar 1991).

1993

PUBLICATIONS, PRESENTATIONS, PATENTS, TR'S

REFEREED PUBLICATIONS:

"Perfluoroalkylations and Perfluorooxaalkylations. Part 1. Bromoaromatics as Substrates in Copper-Mediated Cross-Coupling", *Journal of Fluorine Chemistry*, 63, 113 (1993).

"Vibrational Studies and Ab Initio Calculations of the Conformers of 1,2-Dichloro-1,1,2-trifluoro-2-iodoethane", *Journal of Fluorine Chemistry*, 61, 31 (1993).

"*Ab Initio* Study of Molecular Geometry and the Torsional Potential in Perfluoroethylmethyl Ether", *Journal of Physical Chemistry*, 97, 5901 (1993).

"Vibrational Studies and Ab Initio Calculations of the Conformers of 1,2-Dichloro-1,1,2-trifluoro-2-iodoethane", *Journal of Fluorine Chemistry*, 61, 31 (1993).

"Development of a -54°C to 175°C High Temperature Nonflammable Hydraulic Fluid for Air Force Systems," *Lubrication Engineering*, 49, 621, (1993).

"Effect of Viscosity Index Improvers on the Elastohydrodynamic Lubrication Characteristics of a Chlorotrifluoroethylene and a Polyalphaolefin Fluid," *Tribology Transactions*, 36, , (1993).

"Tribological Behavior of Some Candidate Advanced Space Lubricants," *Tribology Transactions*, 36, 321 (1993).

"Chlorotrifluoroethylene Oligomer Based Nonflammable Hydraulic Fluid, II, Hydraulic Component Development, *Journal of Synthetic Lubrication*, 9, 299 (1992).

"Tribological Behavior of Some Candidate Advanced Space Lubricants," *Tribology Transactions*, 36, 2, 321 (1993).

"Development of a -54°C to 175°C High Temperature Nonflammable Hydraulic Fluid, MIL-H-53119, for Air Force Systems", *Lubrication Engineering*, 49, 621, (1993).

"Chlorotrifluoroethylene Oligomer Based Nonflammable Hydraulic Fluid, I Fluid Additive and Elastomer Development", published in Esslingen Tribology 2000 conference proceedings (1992) and *J of Synthetic Lubrication*, 2, 188 (1992).

"Chlorotrifluoroethylene Oligomer Based Nonflammable Hydraulic Fluid, II Hydraulic Component Development", published in Esslingen Tribology 2000 conference proceedings (1992) and *J of Synthetic Lubrication*, 2, 4, pp 299-309, (1992).

"Effect of Viscosity Index Improvers on the Elastohydrodynamic Lubrication Characteristics of a Chlorotrifluoroethylene and a Polyalphaolefin Fluid", *Tribology transactions*, 36, 3, (1993).

"Soluble Additives for Perfluoropolyalkylethers Liquid Lubricants", *Lubrication Engineering*, 49, 702 (1993).

"Friction Behavior Of Ceramic Fiber-Reinforced Aluminum Metal-Matrix Composites Against A 440C Steel Counterface", *Wear*, 162-164 (1993) 47-56.

- "Utilization Of Raman Spectroscopy In Tribochemistry Studies", *Wear*, 166 (1993) 65-72.
- "Mechanistic Study Of The Synergism Between Sb_2O_3 And MoS_2 Lubricant Systems", *Wear*, 165 (1993) 103-108.
- "Tribological Behavior Of Tic Thin Films Grown By Pulsed Laser Deposition", *Surface and Coatings Tech.*, 56 (1993) 125-130.
- "Characterization Of Pulsed Laser Deposited MoS_2 Thin Films By Transmission Electron Microscopy", *Journal of Materials Research*, 8/11 (1993).
- "The Optimization Of Niobium Diselenide Thin Films Through Control Of Pulsed Laser Deposition Parameters", in *Laser Ablation in Materials Processing: Fundamentals and Applications*, (MRS Symposium Proceedings - 285), Materials Research Society (1993), Pittsburgh, PA, pp 539.
- "Long-Duration Exposure Facility: Preliminary Observations Of The Effects Of Low Earth Orbit On MgF_2 , ThF_4 , And SiO_2 Optical Materials", *Surf. and Interface Analysis*, 20 (1993) 531-34.
- "Growth And Characterization Of C-N Thin Films", *Lubrication Engineering*, (1992) pp 360.
- "Synthesis And Tribological Properties Of Carbon Nitride As A Novel Superhard Coating And Solid Lubricant", *Tribology Transactions, STLE*, 34 (1993) pp 491.
- "Synthesis And Characterization Of Tungsten Disulphide Films Grown By Pulsed Laser Deposition", in press, *J. Mater. Sci.*
- "Self-Lubricating Aluminum Metal-Matrix Composites Dispersed With Tungsten Disulphide And Silicon Carbide", accepted for *Lubrication Engineering*.
- "Tribology Of Tungsten Disulphide (WS_2): Characterization Of Wear-Induced Transfer Films", in press, *Journal of Materials Science Letters*.
- "Analytical Electron Microscopy And Raman Spectroscopy Studies Of Carbon Nitride Thin Films", in press, *JVST-A*.
- "Tribology Of Metal -Matrix Composites: Formation And Attrition Of Third-Body Films", in *Wear Particles: From Cradle To The Grave*, Elsevier, 1992, pp. 121-129.
- "Chemical And Tribological Characteristics Of MoS_2 - PbO Films Deposited By Pulsed Laser Deposition", *Thin Solid Films*, 214 (1992) 156-163.
- "Pulsed Laser Deposition Of Tungsten Disulphide (WS_2) Films On Aluminum Metal-Matrix Composite Substrates", *Journal of Materials Science Letters*, 11 (1992) 1282-1284.
- "Aluminum Metal-Matrix Composites Tailored For Anti-Friction Applications", *Lubrication Engineering* (1992) 442-446.
- "Low Temperature Synthesis Of Carbide Thin Films By Pulsed Laser Deposition (PLD)", in *Photons and Low Energy Particles in Surface Processing*, (MRS Symposium Proceedings - 236), Materials Research Society (1992), Pittsburgh, PA, pp 461-466.

"Synthesis And Tribochemistry Of PbO Films Grown By Pulsed Laser Deposition", in Photons and Low Energy Particles in Surface Processing, (MRS Symposium Proceedings - 236), Materials Research Society (1992), Pittsburgh, PA, pp 437-442.

PATENTS AND INVENTION DISCLOSURES:

"High Temperature (175°C) Nonflammable Hydraulic Fluid Formulation Composition," US 07/882,399, 11 May 1993.

"Lubricity Additive for High Temperature Gas Turbine Engine Oils," US 07/805,352, 23 May 1993.

"Stability Additive for Perfluoropolyalkylethers," US 08/030,969, Filed 12 Mar 1993.

"Perfluoroalkylether Tertiary Alcohols," US 08/003,064, Filed 11 Jan 1993.

"New Processes for Producing Perfluoroalkyl- and Perfluoroalkylether s-Triazines", UD Invention Disclosure #158, 27 August 1993.

"Perfluoroalkylether Tertiary Alcohols", U. S. Patent Application # 08/003,064, 11 January 1993.

Method for Forming Thin Solid Lubricious Films and Film Articles Made Thereby, Patent Number: 5,002,798, Date: 26 Mar 1991; reissued 1992.

Self-Lubricating Aluminum Metal-Matrix Composites Containing Tungsten Disulfide and Ceramic Particles, AF Invention Number 20911, patent in review.

Improved Lubricant Coatings, AF Invention Number 20926, patent in review.

PRESENTATIONS:

"Cross-Coupling Reactions of Perfluoroalkyl and Perfluorooxaalkyl Iodides with Chloroheterocyclic Compounds in the Presence of Copper", Presented at the 206th ACS National Meeting, Chicago, IL, August 1993.

"Initial Metal Fluoride Formation at Metal / Fluorocarbon Interfaces", Presented at the 205th ACS National Meeting, Denver, CO, March 1993.

"FTIR Study of a Perfluoroacyl Fluoride Chemisorption on Alumina", Presented at the 205th ACS National Meeting, Denver, CO, March 1993.

"Synthesis of High-Molecular Weight Perfluorinated Tertiary Alcohols by the Reaction of Fluoroketones and Fluoroalkyltrimethylsilanes", Presented at the ACS Dayton Section, Dayton, OH, February 1993.

"(Perfluoroalkyl) and (Perfluorooxaalkyl)trimethyl Silanes in the Synthesis of Perfluorinated Tertiary Alcohols", Presented at the ACS Eleventh Winter Fluorine Conference, St. Petersburg, FL, January 1993.

"The Analysis of Perfluoropolyalkylethers using Supercritical Fluid Chromatography", Presented at the 1993 Pittsburgh Conference, Atlanta, GA, March 1993. (Abstract No. 688)

"Characterization of Perfluoropolyalkylethers by Supercritical Fluid Chromatography", Presented at the Eleventh Winter Fluorine Conference, St. Petersburg Beach, FL, 28 January 1993. (Abstract No. P34). Also presented at a meeting of the Dayton Section, American Chemical Society, February 1993.

"Pressure-Temperature-Viscosity and Elastohydrodynamic Characteristics of Two Perfluoropolyalkylether Fluids," presented at the 1992 SAE International Fuels and Lubricants Meeting and Exposition, San Francisco, California, October 1992. (Also published in an SAE publication entitled "Rheology and Tribology of Engine Oils", SP-936, 235 (1992).)

"Wear Reduction by a Sulfonamide Additive in Boundary Lubrication of Steel in CTFE Oil," presented at the 9th Wear of Materials Conference, San Francisco, CA, April 1993.

"Surface Film Formation in Boundary Lubrication: I - Dynamics of Dual Film Formation in Boundary Lubrication of Steel"; and "II - Wear Reducing Surface film Formation in CTFE Oil", presented at the Rensselaer Polytechnic Institute, July 1993.

"Surface Film Formation in Boundary Lubrication: I - Wear Reducing Surface Film Formation in CTFE Oil", and "II - Physical Aspects of Friction and Wear Reduction in CTFE Oil", presented at the University of Michigan, August 1993.

"Surface Film Formation in Boundary Lubrication: I - Boundary Lubrication of PFPAs and Their Additives", "II - Wear Reducing Surface Film Formation in CTFE Oil", and "III-Physical Aspects of Friction and Wear Reduction in CTFE Oil", presented at The Ohio State University, October 1993.

"MIL-H-87257 Versus MIL-H-5606 For Nitrile Seals" presented at the SAE A6-C Meeting, New Orleans, LA, May 1993.

"High-Temperature Seals" presented at the SAE CE Meeting, Denver, CO., October 1993.

"Polymers from Chlorotrifluoroethylene", Fluoropolymer Conference 1992, UMIST Department of Chemistry, Manchester, England (1992).

"Fire Resistant Hydraulic Fluids", presented at Society of Automotive Engineers Aerotech '92, Anaheim CA, October 1992.

"Nonflammable Hydraulic Fluids/Seals", presented at Society of Automotive Engineers Aerotech '92, Anaheim CA, October 1992; and also at the Aerotech Atlantic Conference, Dayton OH, April 1993.

"Characterization of Model Perfluoropolyalkylethers by Miniaturized Thermal Oxidative Techniques, Part I - Modified Oxidation-Corrosion Test", presented at the 48th Annual STLE Meeting, Calgary, Canada, May 1993.

"Characterization of Model Perfluoropolyalkylethers by Miniaturized Thermal Oxidative Techniques, Part II - Pressure Differential Scanning Calorimetry", presented at the 48th Annual STLE Meeting, Calgary, Canada, May 1993.

"Separation and Characterization of Perfluoropolyalkylether Lubricant Base Fluids by Supercritical Fluid Chromatography", presented at the 48th annual STLE Annual Meeting, Calgary, Canada, May 1993.

"Tribomaterials And Laser Processing For Extreme Environments", invited lecture, Ohio State University, Dept. of Mechanical Engineering, Columbus, OH, Jan 1993.

"Evaluation Of Pulsed Laser Grown MoS₂, WS₂, And CF_x Films For Use With Perfluoropolyalkylether Fluids", ICMCTF-93, April, 1993, San Diego, CA.

"Initial Metal Fluoride Formation At Metal/Fluorocarbon Interfaces", ACS Spring Meeting, April 1993, Denver CO.

"PLD Feedback Process Control System", ML WUD50/51 Peer Review, 8-9 Dec, 1992.

"Pulsed Laser Deposition Of Niobium Diselenide Thin Films", Presented at the Conference on Laser Ablation (COLA) - 1993, Oak Ridge, TN, April, 1993.

"Determination Of The Critical Thickness For The Onset Of Porosity In Pulsed Laser Deposited Thin Films Of MoS₂", Presented at the Conference on Laser Ablation (COLA) - 1993, Oak Ridge, TN, April, 1993.

"Determination Of The Critical Thickness For The Onset Of Porosity In Pulsed Laser Deposited Thin Films Of MoS₂", Spring Meeting of the Electron Microscopy Society of the Ohio River Valley, Louisville, (1993). (Invited)

"Evolution Of Surface Topography In Pulsed Laser Deposited Thin Films Of MoS₂", 1993 International Conference on Metallurgical Coatings and Thin films (ICMCTF-93), San Diego, (1993).

"Calibration Of An Off-Axis Quartz Crystal Thickness Monitor For A Pulsed Laser Deposition System Using A High Resolution Scanning Electron Microscope", 1993 International Conference on Metallurgical Coatings and Thin films (ICMCTF-93), San Diego, (1993).

"Electron Microscopy Of Pulsed Laser Deposited Thin Films For Tribological Applications", annual meeting of the Microscopy Society of America, Cincinnati, OH, August 1993. (Invited)

"TEM Sample Preparation Of Wear Tested Room Temperature Pulsed Laser Deposited Thin Films Of MoS₂ By Ultramicrotomy", annual meeting of the Microscopy Society of America, Cincinnati, OH, August 1993.

"Tribomaterials For Extreme Environments", STLE Meeting, Sept 1992.

"PLD Of Niobium Diselenide Thin Films", U.S. Army Materials Technology Laboratory, Watertown, MA., Sept, 1992.

"Squeeze Cast Aluminum Metal-Matrix Composites: The Influence Of Microstructure On Friction Characteristics", ASM International Materials Week '92, Chicago, IL, Nov, 1992.

"Properties Of C-N Thin Films Grown By Reactive Magnetron Sputtering", AVS Fall Meeting, Nov 1992.

"Laser Processing Of Tribological Coatings", MRS Fall Meeting, Dec 1992, Boston, MA

"Stoichiometry, Crystallinity, And Tribology Of Graphite Fluoride Films As A Function Of Laser Deposition Parameters", MRS Fall Meeting, Dec 1992, Boston, MA.

"The Optimization Of Niobium Diselenide Thin Films Through Control Of Pulsed Laser Deposition Parameters", MRS Fall Meeting, Dec 1992, Boston, MA.

BOOKS AND NON-REFEREED PUBLICATIONS:

"Quantum Mechanical Studies of Perfluoroalkylethers", Proceedings of the 1992 Scientific Conference on Chemical Defense Research, U. S. Army Chemical and Biological Defense Agency, ERDEC-SP-007, 535 (1993).

"Chlorotrifluoroethylene Oligomer Based Nonflammable Hydraulic Fluid, II, Hydraulic Component Development", Esslingen Tribology 2000 Conference Proceedings (1992).

"Pressure-Temperature-Viscosity and Elastohydrodynamic Characteristics of Two Perfluoropolyalkylether Fluids," published in an SAE publication entitled "Rheology and Tribology of Engine Oils", SP-936, 235 (1992). (Also presented at the 1992 SAE International Fuels and Lubricants Meeting and Exposition, San Francisco, California, October 1992).

"Seal Formulation, Compatibility, and Dynamic Performance in the Chlorotrifluoroethylene (CTFE) Nonflammable Hydraulic Fluid - Volume 2: Compatibility and Long Term Aging of Elastomers in CTFE", WL-TR-91-4046, December 1992.

Synthetic Lubricants and High-Performance Functional Fluids, "Aerospace," chapter, Marcel Dekker, Inc., New York, NY (1993).

"Tribological Materials", in Pulsed Laser Deposition of Thin Films, John Wiley and Sons, New York (1993), in press.

"Electron Microscopy Of Pulsed Laser Deposited Thin Films For Tribological Application", in Proc. of the 51st Annual Meeting of the Electron Microscopy Society of America, San Francisco Press, San Francisco, (1993) pp. 852-3 (Extended Abstract).

"TEM Sample Preparation Of Wear Tested Room Temperature Pulsed Laser Deposited Thin Films Of MoS₂ By Ultramicrotomy", in Proc. of the 51st Annual Meeting of the Electron Microscopy Society of America, San Francisco Press (1993), San Francisco, CA, pp. 1118-9 (Extended Abstract).

1994

PUBLICATIONS, PRESENTATIONS, PATENTS, TR'S

PUBLICATIONS

Because In-House personnel and On-Site contractor personnel comprise the research effort team, many of the articles are co-authored. The following is a listing of articles by the research team that have been published, accepted for or submitted for publication in peer-reviewed journals during the reporting period.

"*Ab Initio* Investigation of Conformational Geometrics and the Torsional Potential Surface in Perfluorodimethoxymethane", C. L. Stanton and M. Schwartz, Journal of Physical Chemistry, 97, 11221 (1994).

"A Computational Investigation of the Molecular Geometry and Rotational Barriers in Ethylmethyl Ether", C. L. Stanton P. Marshall and M. Schwartz, Journal of Molecular Structure (Theochem), 288, 215 (1994).

"Molecular Geometry and the Rotational Potential Surface in Perfluoroisopropylmethyl Ether, C. L. Stanton, R. J. Berry and M. Schwartz, submitted to Journal of Physical Chemistry.

"Degradation of a Branched Perfluoropolyalkylether Fluid with Anhydrous Aluminum Chloride", K. C. Eapen, P. J. John and J. Liang, Macromolecular Chemistry and Physics, 195, 2887 (1994).

"Initial Metal Fluoride Formation at Metal/Fluorocarbon Interfaces", P. J. John and J. Liang, Journal of Vacuum Science and Technology, A12, 199 (1994).

"Conformer Analysis Study of 1,2-Diodotetrafluoroethane by Gas Chromatography/Fourier Transform Infrared Spectroscopy", J. Liang, D. Drake, and M. Roselius, Applied Spectroscopy, 48, 206 (1994).

"Perfluoroalkylations and Perfluorooxaalkylations. Part 2. Copper-Mediated Cross-Coupling of Secondary Perfluorooxaalkyl Iodides and Aryl Halides", G. J. Chen, L. S. Chen and K. C. Eapen, Journal of Fluorine Chemistry, 65, 59 (1993).

"FT-IR Study of a Perfluoroacyl Fluoride Chemisorption on Alumina", J. Liang and M. Roselius, Journal of Fluorine Chemistry, 67, 113 (1994).

"Perfluoro Tertiary Alcohols. III. (Perfluoroalkyl) and (Perfluorooxaalkyl) Trimethyl Silanes in the Synthesis of Perfluorinated Tertiary Alcohols", G. J. Chen, L. S. Chen, K. C. Eapen and W. E. Ward, Accepted for publication, Journal of Fluorine Chemistry.

"Characterization of Model Perfluoropolyalkylethers by Miniaturized Thermal Oxidative Techniques. Part I. - Modified Oxidation-Corrosion Test", L. Gschwender, C. E. Snyder, Jr., G. W. Fultz, D. A. Hahn, and J. R. Demers. Accepted for publication, Tribology Transactions.

"Perfluoroalkylations and Perfluorooxaalkylations. Part 3. Chloro-Substituted Diazines as Substrates in Copper-Mediated Cross-Coupling), G. J. Chen and L. S. Chen. Submitted to Journal of Fluorine Chemistry.

"Wear-Reducing Surface Films Formed by a Fluorinated Sulfonamide Additive in a Chlorotrifluoroethylene-Based Fluid, B. Cavdar, S. K. Sharma, L. J. Gschwender. Accepted for publication, Lubrication Engineering.

"Aerospace Applications of Synthetic Fluids and Lubricants", C. E. Snyder, Jr. and L. J. Gschwender, Chapter in CRC Handbook of Lubrication and Tribology, CRC Press, Ann Arbor (1994).

"A New Technique for the Investigation of Liquid Lubricant Degradation: The Oxidative Corrosion Conductivity Test", J. R. Demers, L. J. Gschwender and C. E. Snyder, Jr., Accepted for publication in Lubrication Engineering.

"Ion Beam Modification of Fullerene Films and Their Frictional Behaviour", R. S. Bhattacharya, S. Rabi, S. Rai, J. S. Zabinski and N. McDevitt, J. of Mat. Res., 9, 1615 (1994).

"Self-Lubricating Aluminum Metal Matrix Composites Dispersed With Tungsten Disulfide and Silicon Carbide", S.V. Prasad and K.R. Mecklenburg, Lubrication Engineering, 50 (1994) 511-517.

"The Use Of Raman Scattering To Study Disorder In Pulsed Laser Deposited Films", N.T. McDevitt, J.S. Zabinski, and M.S. Donley, Thin Solid Films, 240 (1994) 76-81.

"Disorder Induced Low Frequency Raman Band Observed in MoS₂ Films", N.T. McDevitt, J.S. Zabinski, M.S. Donley, and J.E. Bultman, Applied Spec, 48/6 (1993) 733-.

"Characterization Of Pulsed Laser Deposited PbO/MoS₂ Thin Films By Transmission Electron Microscopy", S.D. Walck, M.S. Donley, J.S. Zabinski, and V.J. Dyhouse, J. Mater. Res., 9/1 (1994) 236-245.

Donley, S.D. Walck, T.R. Schneider, and N.T. McDevitt, Tribology Transactions, STLE, .

"Synthesis And Characterization Of A High Temperature Oxide Lubricant", J.S. Zabinski, M.S. Donley, N.T. McDevitt, and C. DellaCorte, J. Mater. Sci., Sept 1993.

"Initial Metal Fluoride Formation at Metal/Fluorocarbon Interfaces", P.J. John and J. Liang, J. Vac. Sci. Technol., A12 (1994) 199-203.

"Degradation Of A Branched Perfluoropolyalkylether Fluid With Anhydrous Aluminum Chloride", K.C. Eapen, P.J. John, and J. Liang, in press Die Makromolekulare Chemie, August 1993.

PRESENTATIONS

"Metal Catalyzed Thermo-Oxidation of Perfluoropolyalkylether Fluids and Property Enhancement Via Soluble Additives", C. E. Snyder, Jr., L. J. Gschwender and J. R. Demers, Presented at the 207th American Chemical Society National Meeting, San Diego, CA, March 1994.

"A New Technique for the Investigation of Liquid Lubricant Degradation: The Oxidation Corrosion Conductivity Test", L. J. Gschwender, C. E. Snyder, Jr., and J. R. Demers, Presented at the Society of Tribologists and Lubrication Engineers Annual Meeting, May 1994.

"Effect of Humidity on Friction and Wear for a Linear Perfluoropolyalkylether Fluid Under Boundary Lubrication Conditions", L. S. Helmick and S. K. Sharma, to be presented at the STLE Annual Meeting, Chicago, IL, May 1995.

"Analytical Methods for the Determination of Wear Metals in Perfluoropolyalkylether Lubricating Fluids", D. W. Johnson, S. J. Thibodeaux and K. J. Eisentraut, Presented at the Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, Chicago, IL, March 1994.

"Determination of Residual Hydrogen Content of Perfluoropolyalkylether Lubricants by FTIR and Proton NMR", J. Liang, M. Roselius and D. Johnson, Presented at the American Chemical Society Annual Meeting, San Diego, CA, March 1994.

"Metal Catalyzed Degradation of Perfluoropolyalkylether-Based Lubricants", D. W. Johnson, Presented at the American Chemical Society Midwest Regional Meeting, Ann Arbor, MI, June 1994.

"Degradation of Perfluoropolyalkylether Based Lubricants by Metal Alloys", D. W. Johnson and T. Wical, Presented at the American Chemical Society National Meeting, Washington, DC, August 1994.

"Wear-Reducing Surface Films Formed by a Fluorinated Sulfonamide Additive in a Chlorotrifluoroethylene-Based Fluid", Presented at the 49th STLE Annual Meeting, May 1994.

"Non-ferrous Fire Resistant Hydraulic Fluids", Presented at the 49th STLE Annual Meeting, May 1994.

"Tribology of Oxide Lubricants Produced by Pulsed Laser Deposition", J.S. Zabinski, M.S. Donley, J.E. Bultman, and N.T. McDevitt, ICMCTF-94, April, 1994, San Diego, CA.

"Laser Processing of Tribomaterials", J.S. Zabinski, invited talk, Distinguished Lecture Series, Auburn University, April, 1994, Auburn, AL.

"Tribology of Self-Lubricating Metal Matrix Composites: Scanning Electron Microscopy of Third Bodies", S.V. Prasad and K.R. Mecklenburg, STLE Annual Meeting, May 1-5, 1994, Pittsburg, PA.

"The Effects of Dopants on the Chemistry and Tribology of Sputter Deposited MoS₂ Films", J.S. Zabinski, M.S. Donley, S.D. Walck, T.R. Schneider, and N.T. McDevitt, STLE Annual Meeting, May 1-5, 1994, Pittsburg, PA.

"USAF Materials Directorate Interactions With the FSU", J.S. Zabinski, Workshop on Materials Research and Development Opportunities in the Former Soviet Union (FSU)", National Academy of Sciences, May, 1994, Washington, D.C.

"Self-Directed Control of Pulsed Laser Deposition", S.J.P. Laube, 1994 Advanced Materials and Processes Conference (AEROMAT '94) Anaheim CA, June 1994.

"Hierarchical Control of Pulsed Laser Deposition", S.J.P. Laube, UC/IAMS Workshop, IAMS Manufacturing Applications, Cincinnati OH, April 9, 1994.

"Tribology of Oxide Lubricants Produced by Pulsed Laser Deposition", J.S. Zabinski, M.S. Donley, J.E. Bultman, and N.T. McDevitt, ICMCTF-94, April, 1994, San Diego, CA.

"Laser Processing of Tribomaterials", J.S. Zabinski, invited talk, Distinguished Lecture Series, Auburn University, April, 1994, Auburn, AL.

"Tribology of Self-Lubricating Metal Matrix Composites: Scanning Electron Microscopy of Third Bodies", S.V. Prasad and K.R. Mecklenburg, STLE Annual Meeting, May 1-5, 1994, Pittsburg, PA.

"The Effects of Dopants on the Chemistry and Tribology of Sputter Deposited MoS₂ Films", J.S. Zabinski, M.S. Donley, S.D. Walck, T.R. Schneider, and N.T. McDevitt, STLE Annual Meeting, May 1-5, 1994, Pittsburg, PA.

"USAF Materials Directorate Interactions With the FSU", J.S. Zabinski, Workshop on Materials Research and Development Opportunities in the Former Soviet Union (FSU)", National Academy of Sciences, May, 1994, Washington, D.C.

"Self-Directed Control of Pulsed Laser Deposition", S.J.P. Laube, 1994 Advanced Materials and Processes Conference (AEROMAT '94) Anaheim CA, June 1994.

"Hierarchical Control of Pulsed Laser Deposition", S.J.P. Laube, UC/IAMS Workshop, IAMS Manufacturing Applications, Cincinnati OH, April 9, 1994.

INVENTION DISCLOSURE

"New Fluorinated Polyether Lubricant Compositions", K. C. Eapen and L. S. Chen, AF Invention #21149, March 1994.

"Metal Complexes of 2,2-Dimethyl-6,6,7,7,8,8,8-Heptafluoro-3,5-Octanedione as Analytical Standards for Fluorinated Fluids", K. J. Eisentraut and David W. Johnson, U. S. Patent Application submitted Nov. 1994.

PATENTS

"Perfluoroalkylether Tertiary Alcohols", C. E. Snyder, Jr., L. J. Gschwender, K. C. Eapen and G. J. Chen, U. S. Patent #5,316,686, 31 May 1994.

"Stability Additive for Perfluoropolyalkylethers", C. E. Snyder, Jr. and L. J. Gschwender, U. S. Patent #5,302,760, April 1994.

NONREFEREED/OTHER PUBLICATIONS

"New Electronics Cooling Fluid", *Flying Safety*, Air Force Special Publication 127-2, 49, 10, Kirtland AFB, NM 87117 (Oct 1993).

"Aerospace Applications of Synthetic Fluids and Lubricants", Book Chapter, E. R. Boozer, Editor, CRC Press, Ann Arbor (1994).

"Synthesis and Characterization of Tungsten Disulfide Films Grown by Pulsed Laser Deposition", J. S. Zabinski, M. S. Donley, S. V. Prasad, and N. T. McDevit, Featured Highlight in, *Optics Report*, November 1994.

1995

PUBLICATIONS, PRESENTATIONS, PATENTS, TR'S

PUBLICATIONS

Because In-House personnel and On-Site contractor personnel comprise the research effort team, many of the articles are co-authored. The following is a listing of articles by the research team that have been published, accepted for or submitted for publication in peer-reviewed journals during the reporting period.

"Boundary Lubrication Thin Film Produced from a Perfluoropolyalkylether Fluid on M-50 Surface Studied by GAM / FTIR Spectroscopy, Part 2: Humidity Effect and Topography Studies", J. Liang, Y. S. Tung, D. O. Henderson, L. S. Helmick and S. Sharma, (*Wear*, submitted, 1996).

"Boundary Lubrication Thin Film Produced from a Perfluoropolyalkylether Fluid on M-50 Surface Studied by GAM / FTIR Spectroscopy, Part 1: Film Characterization and its Thickness Estimation", J. Liang and B. Cavdar, (*Tribological Transactions*, accepted, 1995).

"Tribiochemistry of a PFPAE Fluid on M-50 Surfaces by FTIR Spectroscopy", J. Liang, L. Helmick (*Tribological Transactions*, In Press, 1995).

"Surface Films and Soluble Degradation Products Formed in a PFPAE Fluid and their Implications to the Wear of Steel", B. Cavdar, J. Liang and P. J. John (*Tribological Transactions*, In Press, 1995).

"Residual Hydrogen Determination in Perfluorinated Compounds Using FTIR and Proton NMR Spectroscopies", J. Liang, M. Roselius and D. Johnson (*Applied Spectroscopy*, In Press, 1995).

"Chemisorption Study of Trifluoroacetyl Fluoride on FeF₃ by FTIR Spectroscopy", J. Liang, S. Brooks and M. Roselius (*Journal of Fluorine Chemistry*, In Press, 1995)

"Structure-Property Relationships of Model Chlorotrifluoroethylene Oligomer Compounds: Thermal Stability," C.E.Snyder, Jr., L.J. Gschwender, G.W. Fultz, K.R.L Paciorek and R. Kratzer, *J. Syn. Lubr.* **11**, 3, 163-176 (Oct 1994)

"A New Technique for the Investigation of Liquid Lubricant Degradation: The Oxidative Corrosion Conductivity Test," J.R. Demers, L.J. Gschwender and C.E. Snyder, *Lubr. Eng.* **51**,4, 321-327 (1995).

"Characterization of Model Perfluoropolyalkylethers by Miniaturized Thermal Oxidative Techniques, Part I - Modified Oxidation-Corrosion Test," L. J. Gschwender, C.E. Snyder, Jr., G.W. Fultz, D. A. Hahn and J.R. Demers, *Trib. Trans.*, **38**, 3, 618-626 (1995).

"Characterization of Model Perfluoropolyalkylethers by Miniaturized Thermal Oxidative Techniques, Part II - Pressure Differential Scanning Calorimetry," C.E. Snyder, Jr., L. J. Gschwender and O.L. Scott, *Trib. Trans.*, **38**, 3, 733-737 (1995).

"Fire Resistant Hydraulic Fluids," C E. Snyder, Jr. and L.J. Gschwender, *Lubr Eng.* **51**, 7, 549-553 (1995).

"Computational Chemistry of Soluble Additives for Perfluoropolyalkylether Liquid Lubricants," L. J. Gschwender, C.E. Snyder, Jr., M. Oleksiuk and M. Koehler, Accepted for publication in *Lubr Eng.* (1996).

"Polyalphaolefins and Other Synthetic Hydrocarbons," R.L. Shubkin, L.J. Gschwender and C. E. Snyder, Jr., chapter in *Handbook of Hydraulic Fluid Technology*, George Totten, Ed. (1996).

"Fire Resistant Hydraulic Fluids and Fire Resistant Test Methods Used by the Air Force," C E. Snyder, Jr. and L.J. Gschwender, Fire Resistance of Industrial Oils, ASTM STP 1284, G.E. Totten and J. Reichel, Eds, American Society for Testing and Materials, Philadelphia PA (1995).

"Effect of Humidity on Friction and Wear for a Linear Perfluoropolyalkylether Fluid under Boundary Lubrication Conditions," Helmick, L.S. and Sharma, S.K., accepted for publication by the STLE.

"Rheology of Perfluoropolyalkylether Fluids in Elastohydrodynamic Lubrication," Sharma, S.K., Höglund, E., Hamrock, B.J., and Rosado, L., Trib. Trans, 38, 4, 769-780 (1995).

"On the Traction Behavior of Perfluoropolyalkylether Fluids," Sharma, S.K., Schreiber, B. F., and Gupta, P.K., submitted to the STLE for review and publication.

Perfluoroalkylations and Perfluorooxaalkylations. Part 3. Chloro-Substituted Diazines as Substrates in Copper-Med Cross-Coupling", Journal of Fluorine Chemistry, 73, 113 (1995).

"Perfluoroalkylations and Perfluorooxaalkylations. Part 4. Conversion of Aryl Perfluoroalkanes to Aryl Perfluoroal Ketones", Accepted for publication in Journal of Fluorine Chemistry.

"Regiospecific Synthesis of Aromatic Compounds *via* Organometallic Intermediates. Part 6. 1,3,5-Perfluoroalkyl-et benzenes", Accepted for publication in Journal of Fluorine Chemistry.

"Halon Thermochemistry: Ab Initio Calculations of the Enthalpies of Formation of Fluoromethanes," R. J. Berry, D. R. F. Burgess, Jr, M. R. Nyden, M. R. Zachariah and M. Schwartz. Journal of Physical Chemistry, In Press.

"Halon Thermochemistry: Calculated Enthalpies of Formation of Chlorofluoromethanes," R. J. Berry, D. R. F. Burgess, Jr, M. R. Nyden, M. R. Zachariah, C. F. Melius and M. Schwartz. Submitted to the Journal of Physical Chemistry.

"Characterization of Amorphous-Carbon Thin Films" M.A. Capano, N.T. McDevitt, F. Qian, and R.K. Singh (Submitted to J. Vac. Sci. Technol. B).

"Time-of-Flight Analysis of the Plume Dynamics of Laser-Ablated 6H-Silicon Carbide", M.A. Capano. J. Appl. Phys., 78, 4790-4792 (1995).

"Friction Behavior of Pulsed Laser Deposited Tungsten Disulfide Films", S.V. Prasad, J.S. Zabinski, and N.T. McDevitt, Tribology Transactions, 38 (1995) 57-62.

"Pulsed Laser Deposition of Diamond-Like Amorphous Carbon Films From Graphite and Polycarbonate Targets", A.A. Voevodin, S.J. Laube, S.D. Walck, J.S. Solomon, M.S. Donley, and J.S. Zabinski, J. Appl. Phys, 78 (1995) in press.

"Friction Properties of WS₂/Graphite Fluoride Thin Films Grown by Pulsed Laser Deposition", J.S. Zabinski, M.S. Donley, J.E. Bultman and S.D. Walck, accepted in Surface Coatings and Technology (1995).

"Preparation of Amorphous Diamond-Like Carbon by Pulsed Laser Deposition: Critical Review", A.A. Voevodin and M.S. Donley, Surface Coatings and Technology, in press (1995).

"Characterization of Third-Bodies in Self-Lubricating Aluminum Metal-Matrix Composites by Electron Microprobe Analysis", S.V. Prasad and K.R. Mecklenburg, accepted in Tribology Transactions (1995).

“Mechanical and Tribological Properties of Diamond-Like Coatings Prepared by Pulsed Laser Deposition”, A.A. Voevodin, M.S. Donley, J.S. Zabinski, S.D. Walck, and J.E. Bultman, accepted in Surface Coatings and Technology (1995).

“In Situ Plasma Monitoring of Pulsed Laser Deposition of Diamond Like Carbon Films”, A.A. Voevodin, S.J. Laube, and M.S. Donley, accepted in Surface Coatings and Technology (1995).

“Characterization of Pulsed Laser Deposited ZnO-WS₂ Thin Solid Film Lubricants”, S.D. Walck, N.T. McDevitt, J.E. Bultman, and J.S. Zabinski, Proc. of the 53rd Annual Meeting of the Electron Microscopy Society of America, San Francisco Press, Kansas City (1995).

“TEM Examination of Wear Debris from Self-Lubricating Aluminum Metal Matrix Composites Prepared by Ultramicrotomy”, S.V. Prasad, S.D. Walck, and P.F. Lloyd, Proc. of the 53rd Annual Meeting of the Electron Microscopy Society of America, San Francisco Press, Kansas City (1995).

“Solid Lubricants and Protective Coatings for Perfluoropolyalkylethers”, J.S. Zabinski, L. Gschwender, M.S. Donley, and P. John, Proc. of the 50th Annual Meeting of the STLE, STLE Publications, Chicago, May 1995.

“The Effects of Dopants on the Chemistry and Tribology of Sputter-Deposited MoS₂ Films”, J.S. Zabinski, M.S. Donley, S.D. Walck, T.R. Schneider, and N.T. McDevitt, Tribology Trans. 38/4 (1995) 894.

“Corrosion of Iron by a Perfluoropolyalkylether Identified by Mossbauer Spectroscopy”, G. John, J.S. Zabinski, and V.J. Gupta (accepted for publication in Applied Surface Science).

PRESENTATIONS

“Boundary Lubrication Thin Film and PFPAAE Tribochemistry Studies”, J. Liang, MLBT/POSL IHPTET meeting, Dayton, OH, October 26, 1995.

“Tribochemistry of a PFPAAE Fluid on M-50 Surfaces by FTIR Spectroscopy”, J. Liang and L. Helmick, STLE/ASME Tribology Conference, Orlando, Florida, October 8-11, 1995.

“Boundary Lubrication Thin Film Study by Grazing-Angle-Microscope / FTIR Spectroscopy”, J. Liang, Invited Seminar by Physics Department, Fisk University Nashville, Tennessee, October 5-6, 1995.

“Atomic Force Microscopy Study of Wear Scar Generated on M-50 Surfaces in the presence of a Linear Perfluoropolyalkylether Fluid”, Y. S. Tung, D. O. Henderson, J. Liang and S. Sharma, STM 95 Conference, Snowmass Village, CO 81615, July 23-28, 1995.

“Boundary Lubrication Thin Film Study by Grazing-Angle-Microscope / FTIR Spectroscopy”, J. Liang, Ohio State University International Symposium on Molecular Spectroscopy, Columbus, Ohio, June 12-16, 1995.

“Surface Films and Soluble Degradation Products Formed in a PFPAAE Fluid and their Implications to the Wear of Steel”, B. Cavdar, J. Liang and P. J. John, STLE meeting, Chicago, IL, May 15-18, 1995.

“Humidity and Additive Effects on a PFPAAE Thin Film”, J. Liang, MLBT/ Prof. Steve Granick (University of Illinois) meeting, Dayton, OH, May 9, 1995.

“Boundary Lubrication Thin Film and PFPAAE Tribochemistry”, invited seminar by the Chemistry Department, Cleveland State University, Cleveland, OH, April 27, 1995.

- "FTIR Study of the Trifluoroacetyl Fluoride Chemisorption on FeF₃", J. Liang, poster session, ACS national meeting, Anaheim, CA, April 2-6, 1995.
- "Chemisorption Study of (C₄H₉O)₃PO on Alumina by FTIR Spectroscopy", J. Liang, Ohio Valley Section of the Society for Applied Spectroscopy, Columbus, OH, March 17, 1995.
- "Tribocemical Behavior of a Linear Perfluoropolyalkylether", P. John, J. Zabinski, J. Liang, S. K. Sharma, L. S. Helmick, and B. Cavdar, APS meeting, San Jose, CA, March, 1995.
- "FTIR Microscopy Study of PFPAE-Metal Reaction Products", J. Liang, MLBT/NASA-Lewis meeting, Dayton, OH, February 15, 1995.
- "FTIR Study of the Trifluoroacetyl Fluoride Chemisorption on FeF₃", J. Liang, ACS Dayton section meeting, University of Dayton. Dayton, OH, February, 14, 1995.
- "Boundary Lubrication Thin Film Study by Grazing-Angle-Microscope / FTIR Spectroscopy", J. Liang, MLBT/ Aerospace Co.(CA) meeting, Dayton, OH, February 2, 1995.
- "Tribocemistry Study of Fomblin-Z on M-50 Surfaces by FTIR Spectroscopy", J. Liang, AFOSR/URI meeting, University of Illinois at Urbana-Champaign, IL, August 17-18, 1994.
- "Fire Resistant Hydraulic Fluids," C E. Snyder, Jr. and L.J. Gschwender, presented at the 50th Society of Tribologists and Lubrication Engineers Annual Meeting, May 1995.
- "Computational Chemistry of Soluble Additives for Perfluoropolyalkylether Liquid Lubricants," L. J. Gschwender, C.E. Snyder, Jr., M. Oleksiuk and M. Koehler, presented at the 50th Society of Tribologists and Lubrication Engineers Annual Meeting, May 1995.
- "Solid Lubricant and Protective Coatings for Perfluoropolyalkylethers," J.S. Zabinski, L.J. Gschwender, M.S. Donely and P. John, presented at the 50th Society of Tribologists and Lubrication Engineers Annual Meeting, May 1995.
- "Fire Resistant Hydraulic Fluids and Fire Resistant Test Methods Used by the Air Force," C E. Snyder, Jr. and L.J. Gschwender, presented at ASTM Symposium on Fire Resistance of Industrial Oils (June 20, 1995).
- "Effect of Humidity on Friction and Wear for a Linear Perfluoropolyalkylether Fluid under Boundary Lubrication Conditions," Helmick, L.S. and Sharma, S.K., presented at the 50th annual meeting of the STLE held in Chicago, IL in May 1995.
- "On the Traction Behavior of Perfluoropolyalkylether Fluids," Sharma, S.K., Schreiber, B. F., and Gupta, P.K., presented at the 50th annual meeting of the STLE held in Chicago, IL in May 1995.
- "Synthesis of Aryl Perfluoroalkyl Ketones from Aryl Perfluoroalkanes", Presented at the ACS 12th Winter Fluorine Conference, St. Petersburg, FL, January 1995.
- "Synthesis of Fluorinated Esters", ACS Dayton Section Meeting, Dayton, OH, February 1995.
- "Reactions of Cesium Perfluorotertiary Alkoxides and Perfluorotertiary Alcohols with Reactive Halides", 210th AC National Meeting, Chicago, IL, August 1995.
- "High Temperature Seals" presented at the SAE A6C Committee Meeting, Philadelphia, PA, April 3, 1995.

"SFC Analysis of Fluids for Special Lubricant Applications," H. L. Paige and G. W. Fultz, 22nd Annual Conference of the Federation of Analytical Chemistry and Spectroscopy Societies. Cincinnati, OH, 18 October 1995.

"Thermal Stability of CN_x Thin Films," M. Y. Chen, P. J. John, S. D. Walck, N. T. McDevitt, ICMCTF-95, April, 1995, San Diego, CA.

"Characterization of Pulsed Laser Deposited ZnO-WS₂ Thin Solid Film Lubricants", S.D. Walck, N.T. McDevitt, J.E. Bultman, and J.S. Zabinski, Proc. of the 53rd Annual Meeting of the Electron Microscopy Society of America, Kansas City (1995).

"TEM Examination of Wear Debris from Self-Lubricating Aluminum Metal Matrix Composites Prepared by Ultramicrotomy", S.V. Prasad, S.D. Walck, and P.F. Lloyd, Proc. of the 53rd Annual Meeting of the Electron Microscopy Society of America, Kansas City (1995).

"Solid Lubricants and Protective Coatings for Perfluoropolyalkylethers", J.S. Zabinski, L. Gschwender, M.S. Donley, and P. John, Proc. of the 50th Annual Meeting of the STLE, Chicago, May 1995.

"Characterization of Potential High Temperature Solid Lubricant Thin Films by Analytical Electron Microscopy", S.D. Walck, J.S. Zabinski, M.S. Donley, N.T. McDevitt, and J.E. Bultman, International Conference on Metallurgical Coatings and Thin Films (ICMCTF-95), San Diego April, 1995.

"Friction and Wear of WS₂/Graphite Fluoride Thin Films Grown by Pulsed Laser Deposition", J.S. Zabinski, M.S. Donley, J.E. Bultman, and S.D. Walck, International Conference on Metallurgical Coatings and Thin Films (ICMCTF-95), San Diego April, 1995.

"Structure-Property Relationships of NbN Thin Films Grown by Magnetron Sputtering", K.S. Havey, J.S. Zabinski, S.D. Walck, and W.D. Sproul, International Conference on Metallurgical Coatings and Thin Films (ICMCTF-95), San Diego April, 1995.

"Thermal Stability of CN_x Thin Films", M.Y. Chen, P.T. Murray, P.J. John, S.D. Walck, and N.T. McDevitt, International Conference on Metallurgical Coatings and Thin Films (ICMCTF-95), San Diego April, 1995.

"Mechanical and Tribological Properties of Diamond-Like Coatings Prepared by Pulsed Laser Deposition: Influence of Process Parameters", A.A. Voevodin, M.S. Donley, J.S. Zabinski, and J.E. Bultman, International Conference on Metallurgical Coatings and Thin Films (ICMCTF-95), San Diego April, 1995.

"In Situ Plasma Monitoring of Pulsed Laser Deposition of Diamond Like Carbon Films", S.J. Laube, A.A. Voevodin, and M.S. Donley, International Conference on Metallurgical Coatings and Thin Films (ICMCTF-95), San Diego April, 1995.

"Tribochemical Behavior of a Linear Perfluoropolyalkylether", P.J. John, J. Liang, J.S. Zabinski, S.K. Sharma, L.S. Helmick, and B. Cavdar, APS March Meeting, San Jose, CA March (1995).

INVENTION DISCLOSURE

"Fluid Density Adjustment for Functional Fluids," submitted 18 Feb 95.

Hybrid Magnetron Sputter-Pulsed Laser Deposition Technique, application for US patent filed February 1995, AF Invention # D00072.

NONREFEREED/OTHER PUBLICATIONS

Tripod Polisher Tip #1: Fast Grinding to Optical Transparency on the Second Side, Scott Walck, Microscopy Today (94-5) (1995).