Non-Destructive Characterization of High Performance Composites by Use of X-Ray Refraction Topography 1203
BERND R. MÜLLER, AXEL LANGE and MANFRED P. HENTSCHEL

Magnetic Resonance Sensor for Concrete Assessment 1212
PABLO J. PRADO AND SERGE BOBROFF

Thermal Wave Imaging for Spacecraft Composite Panel Materials Evaluation 1219
THOMAS CHUNG

Damage State of CFRP Characterized Non-Destructively by X-Ray-Refraction-Topography and Ultrasound 1228
VOLKER TRAPPE, KARL-W. HARBICH and HARDY ERNST

Experimental Techniques Used for Observation of Transverse Failure Initiation in Model Multi-Fiber Composites 1240
D. C. FOSTER, G. P. TANDON and M. ZOGHI

PREFORMS—II

Chairmen: Dr. Frank K. Ko, Drexel University/Material Engineering
Patrick Thrash, The Boeing Company

Development in Stitching Systems for the Production of Dry Fiber Preforms 1254
JUERGEN WITTIG

Recent Developments in Automated Composite Preform Production 1260
JUERGEN WITTIG

An Overview of Recent Advances in 3-D Rotary Braiding Technology 1264
A. E. BOGDANOVICH and D. D. MUNGALOV

Book 2

SPORTS/RECREATION

Chairman: Brian S. Hayes

A Commercial Sporting Goods Application for Customized Density Prepregs 1279
ERIC N. GILBERT, BRIAN S. HAYES and RICHARD P. HULOCK
Toughened Low-Temperature Cure VARTM Composites. ............ 1290
MARK A. SHIOLENO and JAYANT R. ANGAL

New Design Concept of Epoxy Resin Formulation Applied to Fibre Reinforced Plastics. ............................... 1299
MAO-CHIAO (JOE) SHIH and WILLIAM M. BANKS

The Use of Thermoplastic Matrix Composite Materials in Making Tubular Composite Structures, such as Golf Shafts. . . . . 1310
MICHAEL E. BUCK, DAVID B. PARK, DAVID STUBBS and CHRISTOPHER WHITE

BRAIDING/WEAVING
Chairman: Alexander Bogdanovich, 3TEX Inc

Wisetex—Virtual Textile Reinforcement Software. ................. 1320
STEPAN V. LOMOV and IGNAAS VERPOEST

Geometrical Characterization of 3-D Warp-Interlaced Fabrics. ................. 1335
F. DESPLENTERE, S. V. LOMOV, D. L. WOERDEMAN, I. VERPOEST, M. WEVERS, P. SZUCS and A. BOGDANOVICH

Ballistic Impact Response of Woven Carbon/Epoxy Composites. ................. 1348
M. V. HOSUR, U. K. VAIDYA, C. ULVEN, A. MAYER and S. JEELANI

Fabrication of 3-D Woven Preforms and Composites with Integrated Fiber Optic Sensors. ................. 1357
A. E. BOGDANOVICH, D. E. WIGENT III and T. J. WHITNEY

3D Woven Composites: Cost and Performance Viability in Commercial Applications. ................. 1372
DONALD STOBBE and MANSOUR MOHAMED

Dynamic Response and Dynamic Fracture of Through-Thickness Reinforced Laminates. ................. 1382
R. MASSABÒ, N. SRIDHAR, L. BRANDINELLI and B. N. COX

ADVANCED METHODS IN DESIGN AND ANALYSIS—II
Chairman: Barry Berenberg, Caldera Composites

The Vibration Analysis and Experiment of the Pre-Delamination Cantilever Composite Beam. ................. 1396
GWO-CHUNG TSAI and YEN-BO LAI
Creating Complete Digital Models of Composite Parts Using CAD-Integrated Software .......................... 1411
OLIVIER GUILLERMIN

New Tools for Rapid Vehicle-Level Finite Element Model Generation ................................................. 1422
MYLES L. BAKER

High Fidelity Structural Integrity Analysis Methodology for Composite Rotorcraft Structures .................. 1430
JIAN LI

FIRE SAFE MATERIALS—II

Chairmen: Usman Sorathia, Naval Surface Warfare Center
Richard E. Lyon FAA/Fire Safety Section

Ignition Resistance of Plastics .................................. 1441
RICHARD E. LYON

Reactive Molecular Dynamics Model of Thermal Decomposition in Polymers ......................................... 1452
STANISLAV I. STOLIAROV, MARC R. NYDEN and RICHARD E. LYON

High Throughput Methods for Polymer Nanocomposites Research: Extrusion, NMR Characterization and Flammability Property Screening ........................................ 1459

Inorganic Core Laminates for Fire Resistance Testing ................................................................. 1475
JOHN ROBINSON and PAUL ANELLO

Characterization of Fire Properties of Commercial Composites ...................................................... 1484
PIET VAN DINE

HIGH TEMPERATURE RESINS—II

Chairman: Michael Meador, NASA Glenn Research Center

Environmental Durability of PMR-Type Polyimide-Clay Nanocomposites ........................................... 1494
MOHAMED O. ABDALLA, DERRICK DEAN and SANDI CAMPBELL
Processable PMR-Type Polyimides: Process-Property Relationships

Thermomechanical Properties of M40J Carbon/PMR-II-50 Composites
RONALD E. ALLRED, E. EUGENE SHIN, LINDA INGHRAM, LINDA MCCORKLE, DEMETRIOS PAPADOPOULOS, DONALD WHEELER and JAMES K. SUTTER

Erosion Resistant Coatings for Polymer Matrix Composites in Propulsion Applications
SUBHASH K. NAIK, JAMES K. SUTTER, RICHARD HORAN, KAZUHISA MIYOSHI, CHERYL BOWMAN, KONG MA, GEORGE LEISSLER, RAYMOND SINATRA and RANDALL CUPP

INFRASTRUCTURE—I
Chairmen: Jerry Bauer, The Aerospace Corporation
Paul Schuman, University of California/San Diego

Durability Characterization of T700 Based Composites for Use in Civil Infrastructure
YAN LI and VISTASP M. KARBHARI

Hygrothermal Degradation of E-Glass/Vinyl Ester Composites Under Sustained Load
CÉLINE S. HELEBLING and VISTASP M. KARBHARI

A Fracture Mechanics Approach to Determination of the Effect of Defects in FRP Strengthening of Concrete
HENNING KAISER, RAJIV NAVADA and V. M. KARBHARI

Use of DMTA for Durability Characterization of Composites
QIANG WANG and VISTASP M. KARBHARI

Recycled Polymer Composites and Their End Use
P. V. VIJAY, HOTAV S. GANGARAO and JOSE R. BASTO

Cyclic Strength and Bond Performance of a Ductile Hybrid FRP Bar for Concrete Structures
FRANK P. HAMPTON, HARRY G. HARRIS and FRANK K. KO

NANOMATERIALS/NANOCOMPOSITES—II
Chairman: Jenn-Ming Yang, University of California/Los Angeles
AUTOMOTIVE

Chairmen:  Dave Stewart, Stewart Auto Research LLC  
Dr. Felix Wu, National Institute of Standards and Technology

Light Weight Composites for Automotive Applications  .......... 1714  
MANSOUR MOHAMED, ROBERT SCHARTOW and BRIAN KNOUFF

Non-Isothermal LCM Process Simulation of an Automotive  
Demonstrator CFRP Part  .................................................. 1727  
MARKUS HENNE, CHRISTIAN WEISSHAUPT and PAOLO ERMANNI

Investigation Into the Light Transmission Characteristics of  
Random Chopped Carbon Fiber Preforms.  ......................... 1742  
JEFFREY DAHL and THOMAS HOSECK

A Method of Measuring Adhesion Between the Plastisol and  
End Cap of Automotive Filters  ........................................ 1753  
WEIQUN WESLEY GU

Rheological Behavior of Oxide Aluminum-Chrome Carbide  
Composite Coating  ..................................................... 1762  
MAKSIM KIREITSEU

AIRCRAFT-FIXED WING

Chairmen:  Alex Velicki, The Boeing Company  
Steven Seid, Hitco Carbon Composites

The Development of the Bow-Type Composite Landing  
Structure for Light Air Vehicles.  .................................... 1771  
C. L. ONG and S. H. CHEN

Acoustic Fatigue of Composite Engine Structures  ............... 1786  
LEVON MINNETYAN and CHRISTOS C. CHAMIS

Airframe Design Concepts for the Advanced Theater Transport.  ... 1799  
ALEX VELICKI

Structural Design Aspects of a Blended-Wing-Body Aircraft.  ... 1808  
ARTHUR V. HAWLEY

Materials Technology for The Boeing 7E7  ......................... 1821  
MARK D. JENKS

Composite Structures on X-37 Airframe  ......................... 1836  
VICTOR L. CHEN and DARWIN G. MOON
CERAMICS, METALS, MMC—I

Chairman: Dr. Thomas Meek, University of Tennessee

Some Electrical Properties of Ion-Implanted Urania—Part II .... 1844
B. G. VON ROEDERN, T. T. MEEK and M. J. HAIREF

Adsorbent Carbon Fiber Composites for the Storage of Natural Gas. .......................................................... 1855
TIM BURCHELL, JANE HOWE, ALEX GABBARD and MIKE ROGERS

Tape Placement of Metal Matrix Composites for Ordnance and Aerospace Applications ......................... 1868
BRIAN L. GORDON

The Influence of Microporosity on Creep Properties and Fracture Mechanism of MAR-M247 Superalloy. .............. 1878

ADVANCED METHODS IN DESIGN AND ANALYSIS—III

Chairman: Prof. Steven R. Nutt, University of Southern California/ Los Angeles/Center for Composite Materials

Delamination Mechanisms in Honeycomb Sandwich Panels .... 1891
RYO OKADA and MARK T. KORTSCHOT

Finite Element Techniques for Modeling Sandwich Composites Subjected to a Transverse Distributed Load per ASTM-D6416. ... 1903
ROBERT F. DOLESKI, STEPHEN J. PLUNKETT, ROBERT W. KLEIN and DAVID TAGGART

Residual Strength of Impact Damaged Composite Sandwich Structures ............................................................ 1915
SARAH E. MOURING, OSCAR BARTON, JR. and PETER J. JOYCE

Material Efficiency and Cost Effectiveness of Sandwich Materials ........................................................................... 1925
JOCHEN PFLUG, BART VANGRIMDE and IGNAAS VERPOEST

Application of Multicontinuum Technology to Grid-Stiffened Structure Design .............................................. 1938
CHRISTOPHER T. KEY, PETER M. WEGNER, JOHN E. HIGGINS and ANDREW C. HANSEN

A New Automatic Thresholding Algorithm Based on Multi-Thresholds ............................................................... 1950
DONGBIN CHEN, GARY HOLLOWAY, MARTIN LEWIN and MANSOOR SARHADI
E-BEAM CURING—I

Chairmen: Catherine Byrne, Science Research Laboratory Inc.
Dr. James M. Sands, Army Research Laboratory

Study on the Process of EB Curing Epoxy Matrix Composites .............................................. 1959
BAO JIANWEN, LI YE, CHEN XiangBAO and SUN XIAODAN

Fundamental Materials Structure-Property Studies for Electron Beam Cured Composites ............................................. 1969
JAEHYUNG JU, YUNTAO LI, JIM LU, SUNG-WON MOON, RAHUL RIBEIRO,
BEN RONCK, FRANCISCO TSCHEN and ROGER MORGAN

Optimized Electron Beam Curable Aerospace Adhesives .......... 1981
LIoudMILA G. BYKANOVA, CATHERINE A. BYRNE, ALEXANDER N. BYKANOV and
DANIEL L. GOODMAN

Electron-Beam Processable Polyimides for High-Performance Composite Applications .............................................. 1993
ANDREA E. HOYT HAIGHT, JAN-MICHAEL GOUSAU, TETYANA SHKINDEL,
MELISSA R. SPROUSE, SHELDON P. WESSON and DAVID A. BABOW

X-Ray Curing Epoxy Adhesive Systems .................................................. 2004
ANDREA E. HOYT HAIGHT, LARRY A. HARRAH and MELISSA R. SPROUSE

AUTOMATED PROCESSING—II

Chairmen: Dr. Norman Johnston, Consultant
Dr. Bruce Hulcher, NASA Marshall Space Flight Center

Pultruded Composites in Impact and Toughness Driven Applications Achieve New Performance Levels with Polyurethane Resin .......................................................... 2016
JOSEPH E. SUMERAK

Thermal Characterization of the Automated Thermoplastic Tow/Tape Placement Process ............................................. 2031
HARRY BELVIN, BRIAN JENSEN and PASCAL HUBERT

Strength Degradation of Filament-Wound Graphite/Epoxy Tubes Due to Either Impact Damage or Fabrication Defects ........ 2042
DICK J. CHANG and HOWARD A. KATZMAN

Bladder Molding A Wet Wound Preform .................................................. 2052
JOE WINTERGERST and D. DeWAYNE HOWELL
Developing A Contoured Deposition Head for In-Situ Tape Laying and Fiber Placement ........................................ 2062
MARK A. LAMONTIA, MARK B. GRUBER, STEVE B. FUNCK, BRIAN J. WAIBEL, RALPH D. COPE and A. BRUCE HULCHER

A Water Soluble Tooling Material for Complex Polymer Composite Components and Honeycombs ................... 2077

INFRASTRUCTURE—II

Chairmen: Jerry Bauer, The Aerospace Corporation
Paul Schuman, University of California/San Diego

Assessment of the Timoshenko Shear Stiffness in FRP Structural Beams .................................................... 2089
MICHAEL D. HAYES and JOHN J. LESKO

An Approach to the Establishment of LRFD for FRP Strengthening .............................................................. 2104
REBECCA A. OLINE and VISTASP M. KARBHARI

Characterization of Concrete-Filled Structural Formwork .............................................................. 2115
DANIELLE BRESTEL, YAEL VAN DEN EINDE, VISTASP M. KARBHARI and FRIEDER SEIBLE

FRP Strengthened Wood-Frame Roofs ............................................. 2129
JOHNN P. JUDD and FERNANDO S. FONSECA

NANOMATERIALS/NANOCOMPOSITES—III

Chairman: Joe Piche, Eikos Inc

Heat Treating Carbon Nanofibers for Optimal Composite Performance ...................................................... 2136
G. G. TIBBETTS, C. KWAG, J. Y. HOWE and M. L. LAKE

Carbon Nanotube Based Transparent Conductive Coatings .............................................................. 2146
PAUL J. GLATKOWSKI

Computer Simulations of Macroscopic Properties of Carbon-Nanotube Polymer Composites ...................... 2153
DEEPAK SRIVASTAVA and CHENYU WEI
Correlation Between Creep-Recovery, Crystallization and Dispersion of Linear Low Density Polyethylene Nanocomposite Films ......................................................... 2164
AJIT RANADE, NANDIKA ANNE D'SOUZA, KASINATH NAYAK, BRUCE GNADE and DEBORA FAIRBROTHER

REPAIR

Chairman: Dr. Mohan M. Ratwani, R-Tec

Composite Repair Patch Development Program for Fighter Aircraft Engine Ducts ......................................................... 2177
A. MAIER, W. RIEDL and G. GÜNThER

Analytical Solutions for Load Increase Factors in Bonded Composite Repairs ................................................................. 2189
J. J. WANG and C. N. DUONG

Innovative FRP Piling Repair Without the Use of Coffer Dams .......................................................................................... 2201
STEVE BAZINET, LARRY CERCONE and FRANZ WORTH

Crack Growth in Repaired Metallic Structures Under Vibratory Loads ........................................................................... 2207
DAVID BANASZAK, HENRY D. BAUST and MOHAN M. RATWANI

ADHESIVES/PAINTS/COATINGS

Chairmen: Manette Gebhardt, Loctite Corporation
Dr. Russell Lipeles, The Aerospace Corporation

Evaluation and Deployment of Environmentally Friendly Bonding Surface Preparations for Naval Aircraft .................. 2219
MATTHEW S. TILLMAN, GEORGETTE B. GASKIN and DONALD O. KNAPP

Ultraviolet Light Surface Treatment as an Environmentally Benign Surface Preparation Method for Adhesive Bonding ........ 2231
A. BHURKE, L. T. DRZAL and P. ASKELAND

Lesson Learned: Solving a Unique Problem Involving the Adhesive in a Critical Thermal Control System .................... 2242
GEORGE EPSTEIN

Vacuum Bag Processed Repair of Bonded Aluminum Honeycomb Structure .......................................................................... 2246
JASON A. SENEKER
Enhancements of Phosphoric Acid Anodizing for Structural Bonding .................................................. 2256
LINDA A. CADWELL STANCIN, BRIAN D. ROCKAFIELD and STACEY A. SULLIVAN

Chrome-Free Single-Step Surface Pretreatment and Primer for Aerospace Coatings .......................... 2267
CHARLES SIZEMORE, HEATHER NEUDER, TAESAM KIM and CHHIU-TSU LIN

Recent Advances in Appliqué Film Technologies for Aerospace Coatings ......................................... 2281
THOMAS S. IHBE and TIMOTHY M. DIETZ

AEROSPACE MARKETS
Chairmen: Jason Hatakeyama, The Boeing Company
Dr. John Connell, NASA Langley Research Center

Design of X-37 Orbital Vehicle .................................................. 2294
FRANK ABDI and TINA CASTILLO

Space Transportation System Design Implications of Emerging Space Tourism Markets .................. 2306
STEVEN J. HOESER

Overview of the Composite Development in Aeronautical Research Laboratory/CSIST ...................... 2321
HO-LING FU

Designing of Stiffened Composite Shell ........................................ 2333
S. J. SUN, D. JUANG, C. H. WANG and G. S. GER

E-BEAM CURING—II
Chairmen: Dr. James M. Sands, Army Research Laboratory
Catherine Byrne, Science Research Laboratory Inc

ATR-IR for Determination of Inhibition in EB Cured Composite Materials ........................................ 2344
LAURA PETRESCUE, KENNETH C. COLE, VINCE J. LOPATA and MARK SHEAD

Influence of Water on UV and EB Induced Polymerization of Glycidyl Ethers ..................................... 2359
GIUSEPPE R. PALMESE and GILA STEIN

Characteristics of an Electron Beam Used for Basic Research Studies on Composite Curing ................. 2370
DONALD A. KLOSTERMAN
Initial Study of Effects of Space Radiation on LTM45 Composite Material

VERNON CALVIN, CHRISTA POLK, JIANREN ZHOU, RICHARD WILKINS and YANG ZHONG

CERAMICS, METALS, MMC—II

Chairman: Dr. Thomas Meek, University of Tennessee

Opening-Mode Interlaminar Fracture Toughness of Fiber Reinforced Metal Laminates

SHUN-FA HWANG and YA-CHERN LIN

A Study on the Fiber Metal Laminated Panel for Blast-Resistant Container

YUNG-LUNG LIU

Co-VARTM Fabrication of Aluminum Foam Composite Panels for Impact Protection

DANA T. GROW, UDAY VAIIDYA and BIJU MATHEW

Endurance Testing of Composite Reinforced Welded Aluminum Structures

LARRY CERCONE, FRANZ WORTH, JUSTIN NADAULD, CHRIS PANTELIDES and HARRY WHITE

FIRE SMOKE TOXICITY

Chairman: Tony Camarota, Avtec Industries

Obtaining NASA Approval for Use of Non-Metallic Materials in Manned Space Flight

SAMUEL E. DAVIS and HARRY L. WISE

A New Material Flammability Apparatus and Measurement Techniques

PATRICIA A. BEAULIEU, NICHOLAS A. DEMBSEY and RONALD L. ALPERT

Composite Flame Retardant and Smoke Suppressing Surfacing Mat

JOHN B. ROWEN

INFRASTRUCTURE—III

Chairmen: Jerry Bauer, The Aerospace Corporation

Paul Schuman, University of California/San Diego
Issues Related to Shear Strengthening .......................... 2464
PAUL M. SCHUMAN and VISTASP M. KARBHARI

Effects of Cutout on the Performance of FRP Cylindrical Shells ... 2479
AIXI ZHOU, DANIELLE BRESTEL and VISTASP M. KARBHARI

FRP Reinforced Steel Free Modular Deck System .................... 2493
LIJUAN CHENG, VISTASP M. KARBHARI and FRIEDER SEIBLE

Impact and Compression Behaviors of Metal/Polymer Composite Hybrid Tubes ........................................... 2503
Y. H. CHUANG, M. F. HSU, W. S. KUO and H. K. LIU

Design of Fiber Reinforced Polymers (FRP) Strengthened Timber Beams .................................................. 2513
YONGXIAN CHEN and P. N. BALAGURU

Fatigue Investigation of Steel-Free Concrete Deck Slab Reinforced with GFRP .................................................. 2525
AMJAD H. MEMON and AFTAB A. MUFTI

NANOMATERIALS/NANOCOMPOSITES—IV
Chairmen: Dr. B. Les Lee, A.F. Office of Scientific Research
Dr. H. Thomas Hahn, University of California/Los Angeles

Thermal and Mechanical Characteristics of Nano Modified Fiber-Reinforced Composites ........................................... 2539
CHRISTI A. SHINER, JOHN F. TIMMERMAN, EBOÑÉE P. M. WILLIAMS and JAMES C. SEFERIS

Preparation of Biodegradable Plastics Based on Nanoengineered Sweet Potato Starch/MPE Blends ......................... 2545
SABYASACHI GANGULI, DERRICK DEAN, ADELLIA BENJAMIN

Carbon Nanoparticles/Whisker Reinforced Composites and Their Tensile Response ............................................. 2559
HASSAN MAHFUZ, ASHFAQ ADNAN, VIJAY K. RANGARI, BOR JANG and SHAIK JEELANI

High Temperature Thermoset Nanocomposites ...................... 2572
DERRICK DEAN, MOHAMED O. ABDALLA, SABYASACHI GANGULI, MONCY JOSE, SANDI CAMPBELL, JEFFREY GILLMAN, WALID H. AWAD and RICHARD VAIA

Processing and Characterization of a Carbon Nanofiber/Vinyl-Ester Resin Composite ....................................... 2585
BRIAN McMORROW, RICHARD CHARTOFF and DON KLOSTERMAN
Formation and Characterization of Electrically Conducting Polymer Micro/Nanotube Blends
A. R. HOPKINS, R. A. LIPELES and W. H. KAO

Carbon Nanofiber Polymer Composites

Prediction of Molecular Interactions and Interfacial Bonding of Nanotube/Epoxy Composites Using Molecular Dynamics Simulation
ZHI YONG LIANG, JI HUA (JAN) GOU, CHUCK ZHANG, ZHI WANG, BEN WANG and LESLIE KRAMER

WIND ENERGY
Chairmen: Dr. Arndt Stephen, Nordex Energy, Germany Walter Musial, National Wind Tech Center

Alternative Composite Materials for Wind Turbine Blades: Design Considerations and Test Evaluation
DAYTON A. GRIFFIN and THOMAS D. ASHWILL

Current Research and Development Efforts for Large Wind Turbine Blades
DAYTON A. GRIFFIN

Effects of Fiber Waviness on Composites for Wind Turbine Blades
J. F. MANDELL, D. D. SAMBORSKY and L. WANG

Efficient Method for Fatigue Testing Multi-Megawatt Composite Wind Turbine Blades Using Resonant Excitation
DARRIS L. WHITE and WALTER D. MUSIAL

Micromechanics of Wavy Fibers Relating to Strength Analysis of Composites
M. R. GARNICH and G. KARAMI

Requirements for the Certification of Rotor Blades
GERD WACKER

Author Index I-1
Company Index I-9
Subject Index I-15