

# Technical Sessions



## TECHNICAL PROGRAM FORMAT

Six to seven technical sessions and/or special interest programs will take place concurrently throughout the conference.

## SPECIAL INTEREST PROGRAMS

The titles, parts, and times for the five special interest programs are listed on the daily program schedule. Detailed descriptions of the individual programs are shown on pages 21–24.

## TECHNICAL SESSIONS

Following is a detailed description of the 42 conference technical sessions. Each session will consist of 3 technical papers presented by authors in English. Individual presentations will last approximately 20 minutes with an additional 5 minutes for questions and answers. Manuscripts from the technical sessions will be included in the conference proceedings.

## SPEAKER INTERACT

At the end of each technical session there will be a 15-minute period for informal discussion in the rear of the room with session speakers. This concept is designed to foster and encourage technical dialogue and information exchange.

## TECHNICAL PROGRAM LISTINGS AS OF JANUARY 9, 2007

Presentation numbers are listed before the author's country(ies). Be sure to visit the MPIF Web site at [www.mpiif.org](http://www.mpiif.org) for changes to the technical program and to view submitted abstracts, where applicable.

# MONDAY, MAY 14

## SPECIAL INTEREST PROGRAMS

(See page 21 for details)

9:45–11:15 a.m. (09:45–11:15)

**SIP 1: Benchmarking Conventional PM with Alternative Metalworking Technologies**

9:45–5:00 p.m. (09:45–17:00)

**SIP 2: PM in Electronics & Thermal Management, Parts 1 & 2 (of 2)**

## TECHNICAL SESSIONS

*Monday morning*

9:45–11:15 a.m. (09:45–11:15)

## SESSION01

### FATIGUE

**Session Chairman:**

W. Brian James, FAPMI  
Hoeganaes Corporation

0127 *U.S.A.*

**Fatigue Behavior of Powder Metallurgy Alloy Steels**

Nik Chawla, J. J. Williams, Arizona State University & K. S. Narasimhan, Bruce Lindsley, Patrick King, Hoeganaes Corporation

0093 *Canada & U.S.A.*

**Fatigue Properties of Carburized Extra-Fine Ni Steels**

Thomas F. Stephenson, Inco Special Products, Lhoucine Azzi, National Research Council, Industrial Materials Institute, Sylvain St. Laurent, QMP & Salvator Nigarura, PMG Ohio Corp.

0012 *Japan*

**Fatigue Strength of Sintered and Carburized Compacts Made of Molybdenum Hybrid-Alloyed Steel Powder**

Shigeru Unami, Yukiko Ozaki, Satoshi Uenosono, JFE Steel Corporation, Steel Research Laboratory

## SESSION02

### CERAMICS, SILICIDES & CERMETS

**Session Chairman:**

Steven A. Miller  
H. C. Starck, Inc.

0140 *U.S.A.*

**Master Sintering-Curve Analysis of Liquid-Phase Sintered, Nanoscale Silicon Carbide Fabricated in a Plasma Pressure Compaction System**

Sundar V. Atre, Manish Bothara, Oregon State University, Seong-Jin Park, Randall M. German, Mississippi State University & T. S. Sudershan, R. Radhakrishnan, Materials Modification, Inc.

0056 *Austria & Germany*

**Mo-Based Silicide Alloys with Balanced Oxidation Resistance and Mechanical Properties**

Pascal Jehanno, Mike Boning, Heinrich Kestler, Plansee SE & Martin Heilmairer, Otto-von-Guericke University of Magdeburg

0007 *China*

**Affection of Mo and Mo<sub>2</sub>C on Microstructure and Properties of the Cermets Based on Ti(C,N)**

Shiquan Zhou, Huazhong University of Science and Technology

## SESSION03

### MODELING I: COMPACTION

**Session Chairman:**

David Milligan  
North American Höganäs, Inc.

0068 *U.S.A.*

**Molecular Dynamics Simulations of Compressive Behavior of bcc-Fe, Fe-Cu, and Fe-Ni Nanoparticles**

Tonya W. Stone, Bohumir Jelinek, Philip M. Gullett, Seong-Gon Kim, Mark F. Horstemeyer, Center for Advanced Vehicular Systems, Mississippi State University

0064 *United Kingdom*  
**Numerical Simulation of Powder  
Compaction and Failure Mechanism  
Investigation**  
Lianghao Han, University of Cambridge

0087 *U.S.A.*  
**Particle Decohesion During Unloading and  
its Effect on Strength and Anisotropy of  
Compacts**  
Wenhai Wang, Antonios Zavaliangos, Drexel  
University

## SESSION 04

### NANOSCALE POWDERS I

#### Session Chairman:

James W. Sears  
South Dakota School of Mines & Technology

0112 *U.S.A.*  
**Economics of Processing Nanoscale Powders**  
John L. Johnson, Kennametal Inc.

0148 *Germany, U.S.A. & Mexico*  
**Nanostructured Materials by HKP in  
Commercial Manufacturing**  
Henning Zoz, Hans-Ulrich Benz, Hongming  
Ren, Zoz GmbH, Animesh Bose, Materials  
Processing, Inc. & David Jaramillo V.,  
CIITEC-IPN, Instituto Politécnico Nacional

0025 *South Africa*  
**Production and Characterization of  
Nanosize (V,W)C Powder by Mechanical  
Alloying**  
Silvana Luyckx, Dave Billing, University of  
the Witwatersrand & Sylvester Bolokang,  
Clever Banganyi, University of Johannesburg

## SESSION 05

### PIM I: POWDER-PROPERTY RELATIONSHIPS

#### Session Chairman:

Ted A. Tomlin  
FloMet LLC

0156 *United Kingdom*  
**Review of the MIM Industry and Recent  
Material Developments in Terms of  
Composition and Powder Size**  
Paul Davies, Sandvik Osprey Ltd.

0018 *U.S.A. & Japan*  
**Metal Injection Molding of Ultrafine 316L  
Stainless Steel Powder**  
Animesh Bose, Materials Processing, Inc. &  
Isamu Otsuka, Takafumi Yoshida, Hisataka  
Toyoshima, Epson Atmix Corporation

0106 *Singapore*  
**Study of Powder Characteristics on  
Mechanical and Dynamic Properties of  
Metal Injection Molding (MIM) Products**  
Chee Keong Tai, Advanced Materials  
Technologies (AMT) Pte. Ltd.

Monday afternoon  
3:30–5:00 p.m. (15:30–17:00)

## SESSION 06

### CHROMIUM STEELS

#### Session Chairman:

Suresh O. Shah  
Cloyes Gear & Products, Inc.

0144 *U.S.A.*  
**Chromium Steels for High-Performance PM  
Applications**  
Patrick King, Bruce Lindsley, Hoeganaes  
Corporation

0060 *U.S.A.*  
**Influence of Processing Conditions on  
Mechanical Properties**  
Ulf Engström, David Milligan, Alexander  
Klekovkin, North American Höganäs Inc.

0013 *Taiwan*  
**The Microstructures and Mechanical  
Properties of B-Containing High-Strength  
FeCrMoNiC Steel Compacts**  
Ming-Wei Wu, Kuen-Shyang Hwang, National  
Taiwan University

## SESSION 07

### NDT

#### Session Chairman:

Anthony Miller, PMT  
Micro Metals, Inc.

0152 *U.S.A.*  
**Testing Sinter-Braze Integrity of Powder  
Metal Carrier Assembly Using Resonant  
Inspection**  
Richard W. Bono, Modal Shop, Inc. & Bryan  
Walker, GKN Sinter Metals

0070 *U.S.A.*  
**Density Prediction through X-Ray  
Computed Tomography in Automotive  
Powder Metallurgy Parts**  
Laura Arias, Youssef Hammi, Mark F.  
Horstemeyer, Center for Advanced Vehicular  
Systems, Mississippi State University

0046 *U.S.A.*  
**One Hundred Percent Testing of Green-  
State PM Compacts through Active and  
Passive Thermography**  
Souheil Benzerrouk, Reinhold Ludwig, Diran  
Apelian, Worcester Polytechnic Institute

## SESSION 08

### MODELING II: COMPACTION

#### Session Chairman:

Mark Osborne  
GM Powertrain

0080 *U.S.A.*  
**Constitutive Modeling of Compaction and  
Sintering for PM Automotive Components**  
Youssef Hammi, Wesley Trim, Laura M. Arias,  
Paul G. Allison, Mark F. Horstemeyer, Center  
for Advanced Vehicular Systems, Mississippi  
State University

0110 *U.S.A.*  
**Achieving Steady State: A Finite-Element  
Analysis of the Temperature Increase  
During Compaction**  
Andrew Marx, Antonios Zavaliangos, Drexel  
University

// PowderMet  
continues to  
present new  
technical  
innovations and  
provide invaluable  
networking opportunities  
year after year. //



Michael Schulz  
Product Manager  
BASF Corporation, USA

# Technical Sessions

0024 U.S.A.

## **Novel Methodology to Quantify Tool Wear in Powder Metallurgy**

James K. Thompson, Seong Jin Park, Randall M. German, Fehim Findik, Arockiasamy Antonyraj, Center for Advanced Vehicular Systems, Mississippi State University

## SESSION 09

### **NANOSCALE POWDERS II**

#### **Session Chairman:**

John E. Smugeresky  
Sandia National Laboratories

0126 U.S.A.

#### **Fabrication of Nano Materials**

Chris Power, Leo V. M. Antony, Timothy N. McKechnie, J. Scott O'Dell, Plasma Processes, Inc. & Kevin Hemker, Budhika Mendis, Johns Hopkins University

0078 U.S.A.

#### **Consolidation of Nanoencapsulated Powder Sheets with Photons**

William Hofmeister, Lino Costa, Zbigniew Sikorski, University of Tennessee Space Institute, Adrian Sabau, Oak Ridge National Laboratory & Dean Baker, Advanced Powder Solutions

0086 U.S.A.

#### **Laser-Engineered Net Shaping of Ti-6Al-4V Metal Matrix Composites Using NanoCoated Powder**

Baolong Zheng, Yizhang Zhou, Enrique J. Lavernia, University of California, Davis, John E. Smugeresky, Sandia National Laboratories & Dean Baker, Advanced Powder Solutions, Inc.

## SESSION 10

### **PIM II: FEEDSTOCK OPTIMIZATION**

#### **Session Chairman:**

Peter A. dePoutiloff, PMTII  
SSI Sintered Specialties

0022 U.S.A.

#### **Binder Optimization for the Production of Tungsten Feedstock in PIM**

Travis E. Puz, Randall M. German, Center for Advanced Vehicular Systems, Mississippi State University & James J. Oakes, ATI Alldyne

0083 Malaysia & U.S.A.

#### **Effect of Particle Shape and Fiber Length on Viscosity of Metal Composite Mixes**

Faiz Ahmad, University of Technology Petronas & Randall M. German, Center for Advanced Vehicular Systems, Mississippi State University

0135 Pakistan & United Kingdom

#### **A Comparative Study of Various PIM Binder Systems**

Muhammad Y. Anwar, University of Engineering and Technology & Hywel A. Davies, University of Sheffield



## TUESDAY, MAY 15

### **SPECIAL INTEREST PROGRAMS**

(See page 22–23 for details)

8:00–4:45 a.m. (08:00–16:45)

**SIP 3: Advanced Compaction Technologies: A Pressing Need, Parts 1, 2 & 3 (of 3)**

**SIP 4: Weird PM: Next Generation Materials, Processes, and Applications, Parts 1, 2 & 3 (of 3)**

### **TECHNICAL SESSIONS**

**Tuesday morning**

8:00–9:30 a.m. (08:00–09:30)

## SESSION 11

### **SINTER HARDENING**

#### **Session Chairman:**

Ian Donaldson  
GKN Sinter Metals

0059 U.S.A. & Sweden

#### **Sinter-hardening Response of Chromium PM Steels**

David Milligan, Roland Warzel, North American Höganäs Inc. & Ulf Engström, Höganäs AB

0149 U.S.A.

#### **Effect of Post-Sintering Thermal Treatments on Dimensional Precision and Mechanical Properties in Sinter-Hardening PM Steels**

Bruce Lindsley, Thomas F. Murphy, Hoeganaes Corporation

0015 Taiwan

#### **Sinter-Hardened Ultrahigh-Strength PM Steels with Homogeneous Alloying and Microstructures**

Kuen-Shyang Hwang, Ming-Wei Wu, National Taiwan University

## SESSION 12

### **FUNCTIONALLY GRADED WC-CO**

#### **Session Chairman:**

G. Kris Schwenke  
OSRAM Sylvania Products Inc.

0111 U.S.A.

#### **A Kinetic Model for the Formation of Cobalt Gradient During Liquid-Phase Sintering in WC-Co Composites**

Oladapo O. Eso, Peng Fan, Zhigang Z. Fang, University of Utah

0065 *U.S.A.*  
**Microhardness of Surface-Binder-Enriched Cemented Carbides**  
Pankaj K. Mehrotra, Kennametal Inc.

## SESSION 13

### COPPER COMPOSITES

**Session Chairman:**  
Lane H. Donoho, PMTII  
Vanderbilt University

0118 *Austria & U.S.A.*  
**Copper-Based Composites Reinforced with Carbon Nanofibers**  
Erich Neubauer, Michael Kitzmantel, ARC Seibersdorf Research GmbH & Ivi Smid, CISP-ESM, Penn State University & Paul Angerer, EICHEM

0005 *Germany*  
**Carbide Formation in Copper-Carbon Composites and its Effect on Thermal Conductivity**  
Thomas Schubert, Hendrik Weidmueller, Thomas Weissgarber, FhG/IFAM

0113 *Korea & U.S.A.*  
**Development of the High-Performance W-Cu Electrode**  
Young-Sam Kwon, Seong-Taek Chung, CetaTech, Inc., Seong Lee, Joon-Woong Noh, Agency for Defence Development (ADD) & Seong-Jin Park, Randall M. German, Center for Advanced Vehicular Systems, Mississippi State University

## SESSION 14

### SINTERING I

**Session Chairman:**  
Thomas Philips  
Air Products and Chemicals, Inc.

0145 *U.S.A.*  
**Growth of Powder Metallurgy and Sintering of Powder Premixes—a Brief Overview**  
Kalathur S. Narasimhan, Frederick J. Semel, Hoeganaes Corporation

0096 *Brazil*  
**Oxidation Evolution of Sintered Iron Parts Steam Treated in an Industrial Continuous Furnace**  
Eduardo Nunes, GKN Sinter Metals

0057 *Germany*  
**Effect of Sintering Furnace on the Fatigue Strength of Fe-1.5Cu-0.6C**  
Ali Zafari, Paul Beiss, Inst. F. Materials Applications in Mechanical Engineering

## SESSION 15

### PIM III: MOLDING TECHNOLOGY

**Session Chairman:**  
Laxmappa Hosamani  
Advanced Forming Technology

0053 *Germany*  
**Production of Precise and Resistive Micro Components by Powder Injection Molding**  
Volker Piotter, Martin Beck, Berthold Zeep, Robert Ruprecht, Juergen Hausselt, Forschungszentrum Karlsruhe

0044 *U.S.A.*  
**Simulation of Binder-Powder Separation in Powder Injection Molding**  
Seongjai Kim, Seong J. Park, Randall M. German, Center for Advanced Vehicular Systems, Mississippi State University & Sundar V. Atre, Oregon State University

0006 *U.S.A.*  
**A Force-Distributing Dental Implant Assembly Using Metal Injection Molding Technology**  
Boney A. Mathew, Mathson Industries, Inc. & Christopher Ford, The Dental Depot

**Tuesday morning**  
10:45 a.m.–12:15 p.m. (10:45–12:15)

## SESSION 16

### SURFACE DENSIFICATION

**Session Chairman:**  
Shiz Kassam  
Keystone Powdered Metal Company

0054 *Germany*  
**Rolling-Contact Fatigue of a Case-Hardened High-Density PM Steel**  
Ivo Saueremann, Paul Beiss, Inst. F. Materials Applications in Mechanical Engineering

0045 *Germany*  
**Surface Densification for High-Performance PM Components**  
Lorenz S. Sigl, Gunter Rau, Christian Dennert, PMG Füssen GmbH

0088 *Canada*  
**Design and Development of PM Pinions**  
Roger Lawcock, Huw David, Michael Renahan, Stackpole Limited

## SESSION 17

### TUNGSTEN CARBIDE POWDERS

**Session Chairman:**  
Zhigang Fang  
University of Utah

0062 *India*  
**Application of Nanotechnology for Development of Wear- and Corrosion-Resistant Tools**  
Mohammed Hamiuddin, Mukesh K. Garg, AMU & Praveen Pachauri, NIET, Noida

0090 *U.S.A.*  
**Laser Powder Deposition of WC Materials for Improved Wear Resistance**  
James W. Sears, Aaron Costello, South Dakota School of Mines & Technology

0095 *China*  
**Bonding-Strength Evaluation of Aggregates in Ultrafine WC Powders**  
Chenguang Lin, General Research Institute for Non-Ferrous Metals & Ruijun Cao, Chengchang Jia, University of Science and Technology Beijing

// Due to the location of our plant, it is difficult for suppliers to visit us. The annual MPIF conference gives me the opportunity to exchange ideas with suppliers and learn what is new in the PM industry. //



Dave Morasch, PMT  
Press Operations Manager  
Western Sintering Company, USA

# Technical Sessions

## SESSION 18

### HIGHLY ALLOYED MATERIALS

#### Session Chairman:

Thomas F. Stephenson  
Inco Special Products, *Canada*

0071 *U.S.A.*

#### Microstructure and Mechanical Properties of 3DP-Fabricated Tool Steel

Steven C. Johnson, Pennsylvania State University DuBois & Jianxin Liu, Howard A. Kuhn, ProMetal Division, The Ex One Company

0035 *Germany & Sweden*

#### Properties and Application Experiences of New Tool Steels for Powder-Pressing Applications

Richard Jervis, Börje Johansson, Lennart Jönson, Odd Sandberg, Uddeholm Tooling AB

0058 *India*

#### Development of Hard, Wear- and Corrosion-Resistant Stellites by Liquid-Phase Sintering

Mohammed Hamiuddin, AMU

## SESSION 19

### SINTERING II

#### Session Chairman:

Carl Blais  
Laval University, *Canada*

0048 *U.S.A.*

#### Linking Homogenization and Densification in Tungsten Heavy Alloys

Seong J. Park, Randall M. German, Center for Advanced Vehicular Systems, Mississippi State University, Guneet Sethi, Pennsylvania State University & John L. Johnson, Kennametal Inc.

0029 *U.S.A.*

#### Sintering Window for Supersolidus Liquid-Phase Sintering of Tool Steel for Injection Mold Tooling

Jianxin Liu, Howard A. Kuhn, John Arlotti, The Ex One Company

0011 *Russia*

#### Diffusion Interaction between Two Metals, One of Which Is in Liquid State

Arnold P. Savitskii, Institute of Strength Physics and Materials Science

## SESSION 20

### PIM IV: DEBINDING TECHNOLOGY

#### Session Chairman:

Paul Davies  
Sandvik Osprey Ltd, *United Kingdom*

0014 *Taiwan*

#### Causes of Defects and Deformations in Metal Injection Molded Components During Solvent Debinding

Yang-Liang Fan, Kuen-Shyang Hwang, National Taiwan University

0073 *U.S.A.*

#### New MIM Debinding Systems Employing Supercritical Fluids

Rolf Schlake, Al Kazianas, Applied Separations, Inc.

0136 *Pakistan & United Kingdom*

#### The Influence of Stirring on the Kinetics of Water Dissolution of a Composite Binder from Injection Moulded Powder Compacts

Muhammad Y. Anwar, University of Engineering and Technology, Hywel A. Davies, Petter F. Messer, B. Ellis, University of Sheffield & Muhammad T. Zahid Butt, University of Punjab

Tuesday afternoon, May 15

3:15–4:45 p.m. (15:15–16:45)

## SESSION 21

### HIGH-STRENGTH PM STEEL

#### Session Chairman:

Blaine A. Stebick  
Horizon Technology Inc.

0124 *U.S.A.*

#### High-Strength Powder Metallurgy Materials

Francis Hanejko, Patrick King, Bruce Lindsley, Arthur Rawlings, Hoeganaes Corporation

0116 *U.S.A.*

#### Carburized High-Strength PM

Ian W. Donaldson, GKN Sinter Metals & Francis Hanejko, Hoeganaes Corporation

0115 *Iran & Austria*

#### Effect of Double Compacting on Mechanical Properties of Cr-Mo Prealloyed PM Steels

Mazyar Azadbeh, Sahand University of Technology & Herbert Danninger, Christian Gierl, Vienna University of Technology

## SESSION 22

### TESTING & EVALUATION

#### Session Chairman:

Gregory A. Shoales  
United States Air Force Academy

0147 *U.S.A.*

#### Metallographic Analysis of PM Fracture Surfaces

Thomas F. Murphy, Bruce Lindsley, Hoeganaes Corporation

0123 *U.S.A.*

#### Image Analysis—A Tool to Predict Parts Behavior

Roxana Ruxanda, Richard A. Obara, Emerson Climate Technologies

0129 *U.S.A.*

#### Characterization of Functionally Graded WC-Co Composites Using Hertzian Indentation Technique

Haibo Zhang, Zhigang Zak Fang, University of Utah

## SESSION 23

### ATOMIZATION

#### Session Chairman:

Robert M. Gasior  
Carpenter Powder Products Inc.

0092 *U.S.A.*

#### Atomization-Gas-Flow Effects on Preparation of Ultrafine Iron Aluminide Powder

Iver E. Anderson, Robert L. Terpstra, Ames Laboratory, Iowa State University & Richard S. Figliola, Clemson University

0117 *United Kingdom*

#### High-Frame-Rate Analysis of Spray Cone Geometry During Close-Coupled Gas Atomization

Andrew M. Mullis, Robert F. Cochrane, Zabeada Aslam, University of Leeds & Nicholas J. Adkins, CERAM Research

0069 U.S.A.

**Gas-Atomized  $MRE_2Fe_{14}B$  Permanent-Magnet Particulate with Enhanced High-Temperature Performance**

Peter K. Sokolowski, Iver Eric Anderson, Wei Tang, Yaqiao Wu, Kevin W. Dennis, Matthew J. Kramer, R. William McCallum, Ames Laboratory of USDOE, Iowa State University

SESSION 24

**SINTERING III**

**Session Chairman:**

Steven K. Smith, PMT Sinterite Furnace Division

0160 U.S.A.

**Microwaves in Metallurgy: a New Era Based on Extraordinary Discoveries**

Rustum Roy, Pennsylvania State University & Arizona State University

0061 Finland

**Direct Metal Laser Sintering in Biomedical Part Manufacturing**

Juha Kotila, Tatu Syvanen, Maria Latikka, Olli Nyrhila, Jouni Hanninen, EOS Finland

0077 Colombia

**Modeling of Superficial Sintering Enhancement by Abnormal Glow Discharges (AGD)**

Fritz A. Campo, Jairo A. Escobar, Universidad de los Andes

SESSION 25

**PIM V: SINTERED PROPERTIES**

**Session Chairman:**

John L. Johnson  
Kennametal Inc.

0028 Japan

**Improvement of the Properties of Ti-6Al-7Nb Alloy by Metal Injection Molding**

Hideshi Miura, Kyushu University, Yoshinori Itoh, Kenji Sato, Toshiaki Uematsu, Hamamatsu Industrial Research Institute of Shizuoka Prefecture & Mitsuo Niinomi, Tohoku University

0094 U.S.A.

**The Influence of Microstructure on the Mechanical Properties of 17-4PH Stainless Steel**

James A. Sago, Mark W. Broadley, John K. Eckert, Roger J. White, Accellent Inc.

0182 U.S.A.

**Material Advancements for MIM Applications**

Timothy J. McCabe, Chandru Vaidyanathan, Kinetics—A Division of Climax Engineered Materials

WEDNESDAY, MAY 16

**SPECIAL INTEREST PROGRAMS**

(See page 23 for details)

8:00–12:15 p.m. (08:00–12:15)

**SIP 5: Advanced Materials and Processes Applied to Non-Automotive Applications, Parts 1 & 2 (of 2)**

**TECHNICAL SESSIONS**

**Wednesday morning**

8:00–9:30 a.m. (08:00–09:30)

SESSION 26

**ALUMINUM ALLOYS**

**Session Chairman:**

Jean C. Lynn  
DaimlerChrysler Corp.

0008 U.S.A.

**Mechanical and Physical Properties of Novel Scandium-Containing Mixed Powder Sintered Aluminum**

Fehim Findik, James K. Thompson, Arockiasamy Antonyrau, Seong Jin Park, Randall M. German, Center for Advanced Vehicular Systems, Mississippi State University

0039 Australia

**Fatigue of a Sintered 2xxx Series Aluminum Alloy**

Graham B. Schaffer, Gemma N. Grayson, The University of Queensland & John R. Griffiths, CSIRO

0032 Mexico & Spain

**Tribological Behavior of Aluminum Matrix Composites Reinforced with TiN Particles Consolidated by Powder Extrusion**

Mario A. Perez, Jose L. Ortiz, ITESM Campus Queretaro, Vicente Amigo, Universidad Politécnic de Valencia, Federico Manriquez, Rene Antano, CIDETEQ & Carlos Velazquez, Instituto Tecnológico de Minatitlán

SESSION 27

**NANOCRYSTALLINE REFRACTORY METALS & CARBIDES**

**Session Chairman:**

Animesh Bose  
Materials Processing, Inc.

0131 U.S.A.

**Nanostructured Cemented Tungsten Carbide Sintered by a Ultra-High-Pressure Rapid Hot Consolidation Process**

Xu Wang, Zhigang Zak Fang, Hong Yong Sohn, University of Utah

0153 U.S.A.

**Production of Nanocrystalline Tungsten Using Ultra-High-Pressure Rapid Hot Consolidation**

James D. Paramore, Zhigang Z. Fang, Haibo Zhang, University of Utah, David Siddle, Kennametal Inc. & Kyu Cho, Army Research Laboratory



# Technical Sessions

0050 *Korea*

## Synthesis of Nanosized Mo Powder and Its Sintering Characteristics

Gil-Su Kim, Hai-Gon Kim, Young Do Kim, Hanyang University, Sung-Tag Oh, Seoul National University of Technology, Myiung-Jin Suk, Kangwon National University & Yangdo Kim, Pusan National University

## SESSION 28

### MODELING III: SINTERING

#### Session Chairman:

Alain Marcotte  
Domfer Metal Powders Ltd.

0049 *U.S.A.*

#### Atomistic Simulations of Activated Sintering of Tungsten by Additives

Seong-Gon Kim, Amitava Moitra, Sungho Kim, Seong Jin Park, Randall M. German, Center for Advanced Vehicular Systems, Mississippi State University

0104 *U.S.A.*

#### Multi-Phenomena Simulation of Electric Field-Assisted Sintering

Brandon McWilliams, Antonios Zavaliangos, Drexel University

0114 *Iran & Austria*

#### Non-Destructive Technique to Evaluate Young's Modulus of Cr-Mo-Alloyed Sintered Steels

Maziyar Azadbeh, Sahand University of Technology & Herbert Danninger, Christian Gierl, Vienna University of Technology

// Any company ... will gain a tremendous amount of knowledge and the ability to benchmark their company in relation to the rest of the PM industry. I view this as a great management development tool ... that helps participating companies in the long run. //



Shiz Kassam  
Director, Advanced Product Engineering  
Keystone Powdered Metal Company  
USA

## SESSION 29

### COMPACTION I

#### Session Chairman:

Jack Krajcirik  
Dorst America, Inc.

0143 *U.S.A.*

#### Compaction of Bilayer Tablets

Pamela C. Panos, Antonios Zavaliangos, Drexel University

0128 *U.S.A.*

#### Development of 1,000-Ton Combustion-Driven Compaction Press for Materials Development and Processing

Karthik Nagarathnam, Aaron Renner, Donald Trostle, David Kruczynski, Dennis Massey, UTRON Inc.

0107 *Russia*

#### Electro-Discharge Compaction of High-Speed Steel Powder

Evgeny G. Grigoryev, Vladimir G. Grigoryev, Moscow Engineering Physics Institute

## SESSION 30

### PM FOAMS

#### Session Chairman:

Arun Chattopadhyay  
United States Bronze Powders, Inc.

0130 *U.S.A.*

#### Fabrication of Metallic Honeycomb Using a Co-Extrusion Process

Stephen C. Johnson, Zhigang Zak Fang, University of Utah

0016 *Egypt*

#### Manufacturing of Copper Foams by Powder Metallurgy—Lost Carbonate Process

Saleh H. Kaytbay, CMRDI

0089 *U.S.A.*

#### Development and Characterization of Porous Metallic Support Structures for Hydrogen-Separation Membranes

Robert L. Terpstra, Iver Eric Anderson, Ames Laboratory/Iowa State University & Stephen N. Paglieri, Los Alamos National Laboratory

## SESSION 31

### MIXING TECHNOLOGY

#### Session Chairman:

Rohith Shivanath  
Stackpole Limited, *Canada*

0150 *Canada*

#### Improved Dimensional Stability of Sinter-Hardening Powders through Optimized Mix Formulation and Additives Selection

Sylvain St-Laurent, QMP

0158 *U.S.A.*

#### Effectiveness of Fully Alloyed Precursor Powders and Fine Particle Sizes in Sinter-Growth Control of Iron-Copper-Nickel-Graphite Compacts

John Michiels, Neal Blossom, William H. Shropshire, American Chemet Corporation

0161 *U.S.A. & Japan*

#### Properties of New Segregation-Free Powder for High-Density Applications

Hironori Suzuki, Kobelco Metal Powder of America, Inc. & Satoshi Nishida, Kobe Steel, Ltd.

Wednesday morning

10:45 a.m.–12:15 p.m. (10:45–12:15)

## SESSION 32

### STAINLESS STEEL

#### Session Chairman:

Salvator Nigarura  
PMG Ohio Corporation

0041 *U.S.A. & Sweden*

#### Optimization of Corrosion Resistance and Machinability of PM 316L and 316LSC

Prasan K. Samal, Bo Hu, North American Höganäs & Ingrid Hauer, Owe Mars, Höganäs AB

0159 *U.S.A.*

#### AISI Grades of Stainless Steel for PM Applications

Christopher T. Schade, Hoeganaes Corporation, John Schaberl, Ancor Specialties & Alan Lawley, Drexel University

0121 *India*

#### Corrosion Behavior of Sintered Aluminide-Reinforced 434L and 316L Stainless Steel

Anish Upadhyaya, S. Balaji, Garima Joshi, Pritha Vijay, Indian Institute of Technology

## SESSION 33

### TITANIUM POWDER

**Session Chairman:**

Patrick J. McGeehan  
Hoeganaes Corporation

0040 *South Africa*

**Mechanical Alloying and Nanophase Crystallinity in Ti Alloys**

Hilda K. Chikwanda, Mawejja Kasonde, CSIR & Antoine F. Mulaba, University of Johannesburg

0047 *U.S.A.*

**Applications and Opportunities for Armstrong Titanium Powder**

James W. Sears, South Dakota School of Mines and Technology & Stanley Borys, Taras Lyssenko, International Titanium Powder

## SESSION 34

### MODELING IV: APPLICATIONS

**Session Chairman:**

Russell A. Chernenkoff  
Ford Motor Company

0079 *U.S.A.*

**Determination of Microstructure-Property Relations for Performance and Design Optimization of the PM Process**

Paul G. Allison, Youssef Hammi, Mark F. Horstemeyer, Mississippi State University

0023 *U.S.A.*

**Thermal Expansion and Viscoelastic Properties of Sintered Porous Ferrous Components**

Antonyraj Arockiasamy, Seong Jin Park, Randall M. German, Center for Advanced Vehicular Systems, Mississippi State University

0141 *U.S.A. & India*

**Master Decomposition Curve of Nanoparticulate-Filled Polymers**

Sundar V. Atre, Valmika Nathan, John Simonsen, Oregon State University, Seong-Jin Park, Randall M. German, Mississippi State University & Vijayamohan K. Pillai, National Chemical Laboratory

## SESSION 35

### COMPACTION II

**Session Chairman:**

Michael J. Caruso  
Gasbarre Products, Inc.

0004 *U.S.A.*

**Reducing Ejection Forces by Applying Nonuniform External Pressure to a Balanced Die**

Mark W. Richman, Michael J. McKinstry, Anthony B. Saccoccia, Aaron B. Shea, Worcester Polytechnic Institute

0042 *United Kingdom*

**The Influence of Airflow on Gravity and Suction Filling**

Farhad Motazedian, Csaba Sinka, University of Leicester & Alan Cocks, University of Oxford

0183 *Japan*

**Introduction of an Emerging Compaction Technology—Spark Plasma Sintering (SPS)**

Masao Tokita, SPS Syntex Inc.

## SESSION 36

### MACHINING I

**Session Chairman:**

Gilles L'Espérance, FAPMI  
École Polytechnique de Montréal, *Canada*

0125 *U.S.A.*

**The Use of a New Machining Additive in Ferrous PM Parts to Improve Machinability**

Bruce Lindsley, Sunil Patel, Hoeganaes Corporation & Suresh Shah, Gregory Falleur, Chanley Chambers, Cloyes Gear & Products, Inc.

0085 *Canada*

**Role of Binder/Lubricants in Green Machining**

Carl Blais, Etienne Robert-Perron, Université Laval & Sylvain Pelletier, Yannig Thomas, Industrial Materials Institute (IMI-CNRC)

0001 *India*

**Studies on the Machining Characteristics of 5%SiC-Aluminum Metal Matrix Composite**

Krishna Mohana Rao Gurram, P. Chandrasekhar, A. Srinivasa Rao, S. Siva Rama Krishna, N. Muniraja, JNTU College of Engineering

## SESSION 37

### LIQUID-PHASE-SINTERED TUNGSTEN

**Session Chairman:**

Donald T. Whychell, Sr., FAPMI  
CM Furnaces, Inc.

0122 *India*

**Sintering Response of Tungsten-Coated Copper Powder and Its Effect on Mechanical Properties**

Anish Upadhyaya, Avijit Mondal, Indian Institute of Technology

0030 *U.S.A.*

**Gravitational Effects on Microstructures in Liquid-Phase Sintering**

Louis G. Campbell, Eaton Electrical-VI Technology & Randall M. German, Center for Advanced Vehicular Systems, Mississippi State University

0031 *U.S.A.*

**Gravitational Effects on Hardness in Liquid-Phase Sintering**

Louis G. Campbell, Eaton Electrical-VI Technology & Randall M. German, Center for Advanced Vehicular Systems, Mississippi State University

**Wednesday afternoon**

1:30–3:00 p.m. (13:30–15:30)

## SESSION 38

### COPPER INFILTRATION

**Session Chairman:**

Eric Day  
Capstan Atlantic

0099 *U.S.A.*

**Mechanical Properties of Copper-Infiltrated Low-Alloy Steels Using Wrought Wire Infiltrant**

Howard I. Sanderow, Management & Engineering Technologies & Paul A. Rivest, Ultra Infiltrant

0034 *U.S.A.*

**Mechanical Properties of Copper-Infiltrated Particulate Iron**

Joseph H. Bularzik, Corey J. Hopper, Purdue University Calumet

# Technical Sessions

0033 U.S.A.

## Improving Properties through the Use of Spinodal Alloys

Kenneth Watson, William Ullrich, William Morrissey, Robert Gotham, ACuPowder International, LLC

## SESSION 39

### MECHANICAL PROPERTIES

#### Session Chairman:

Joseph W. Newkirk  
University of Missouri–Rolla

0101 U.S.A.

## Strain-Life-Fatigue Behavior of Powder Metallurgy Aluminum Composites Containing Up to 10% Ceramic Reinforcement

Russell A. Chernenkoff, Ford Motor Company & Chaman Lall, Shuhai Huo, Metal Powder Products Company

0098 Japan

## Material Design and Development of Consolidated Nanocrystalline Ceramics with High-Strength and High-Speed Superplasticity

Hiroshi Kimura, National Defense Academy

0134 U.S.A.

## Evaluation of Fracture Toughness Using Palmqvist's Method Applied to TCHP Hard Metals

Ivi Smid, Ben Risser, Michael Huff, Penn State University & Rick Toth, John Keane, Jon Smith, Allomet Corp.

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James H. Neill  
Vice President Sales  
CM Furnaces, Inc., USA

## SESSION 40

### MODELING V: FILLING

#### Session Chairman:

William R. Gasbarre  
Gasbarre Products, Inc.

0027 U.S.A.

## Self-Similar Aspects of Particulate Materials Processing

Randall M. German, Center for Advanced Vehicular Systems, Mississippi State University

0066 U.S.A. & Netherlands

## Numerical Investigations of Mixing for Powder Injection Molding Feedstock

Seong-Jin Park, Randall M. German, Mississippi State University, Tae Gon Kang, Eindhoven University of Technology & Sundar V. Atre, Oregon State University

0067 U.S.A.

## Die-Filling and Powder Transfer Modeling Using Discrete Element Methods

Tonya W. Stone, Youssef Hammi, Philip M. Gullett, Mark F. Horstemeyer, Center for Advanced Vehicular Systems, Mississippi State University

## SESSION 41

### PROCESSING TECHNIQUES

#### Session Chairman:

Eric J. Reinert  
Bronson & Bratton, Inc.

0138 India

## Spray Forming of 2024 and Al-Si Alloys

Anish Upadhyaya, P. Dash, S. Tandon, Indian Institute of Technology

0010 India

## Improved Dispersion of Graphite in Silver-Graphite Composite Contact Materials by Electroless Coating

Prakash B. Joshi, Bharati R. Rehani, Arun R. Pratap, M.S. University of Baroda & V. K. Kaushik, Indian Petrochemicals Corporation Limited

0081 China

## Investigation on the Microstructure of the Spray-Formed V4 Cold Working Mould Steel and Its Forging Process and Spheroidizing Annealing

Haisheng Shi, Fei Yan, Junfei Fan, Hairong Le, Binzhong Jin, Yong Peng, Shanghai Baosteel Research Institute

## SESSION 42

### MACHINING II

#### Session Chairman:

Ronald E. Arble, PMT  
Hawk Precision Components Group

0109 U.S.A.

## Machining Powder Metal with CBN

Vincent G. Girard, Edward E. Elie, MAX-TEK, LLC

0103 United Kingdom

## Tribological Aspect of PM Machinability by Using TiCN/Al<sub>2</sub>O<sub>3</sub>, CrAlTiN+MoS<sub>2</sub> & Diamond-Like Carbon (DLC) Coatings

Cutting Tools  
C.J. Chang