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## KEYWORD SUBMISSION FORM

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Author \_\_\_\_\_

Paper No. (required) \_\_\_\_\_

Paper Title \_\_\_\_\_

### I. Design & Modeling of PM Materials, Components & Processes

- A: General
  - Horizontal constraints
- B: Constitutive Equations for Computer Aided Engineering
- C: Modeling/Finite Element Analysis
  - Compaction
  - Compaction modeling
  - Deformation behavior
  - Density gradients
  - Density variation
  - Design criteria
  - Ejection
  - Particle dynamics
  - Simulation
  - Stress analysis
  - Tool deflection
- D: Particulate Production Modeling
- E: CAD/CAM
- F: Ergonomics

### II. Particulate Production

- A: General
  - Composition segregation
  - Decomposition of oxides
  - Elemental powder
  - Prealloyed powders
  - Spherical powders
- B: Atomization
  - Centrifugal
  - Gas
  - Impact
  - Spray
  - Water
- C: Handling
  - Alloying Techniques
  - Ball milling
  - Coated powder
  - Cooling rate control
- D: Production Methods & Processes
  - Magnetic separation
  - Mechanical alloying
  - Microalloying
  - Oxygen control
  - Partially prealloyed
  - Plasma powder production

- Powder blending
- Powder synthesis
- Reaction milling
- Reaction synthesis
- Rotating discs
- Rotating electrodes
- Vacuum annealing process
- Vapor deposition
- E: Material Characterization
  - Adsorption
  - Microstructure
  - Morphology
  - Packing characteristics
  - Particle characteristics
  - Particle size
  - Particle size distribution
  - Phase identification
  - Powder hardness
- F: Particulate Size Classification
- G: Other
  - Fine powders
  - Milling equipment
  - Nano powders

### III. General Compaction & Forming Processes

- A: General
  - Compactability
  - Compressibility
  - Deformation behavior
  - Densification
  - Elastic compression effect
  - Rapid solidification
- B: Lubricants
  - Graphite
  - Tribology
  - Zinc stearate
- C: Spray Forming
- D: Additive Manufacturing/Rapid Prototyping
- E: Pressing Techniques & Advances
  - Controlled porosity
  - Double-pressing double sintering
  - Dynamic compaction
  - Explosive compaction
  - Magnetic pulse pressing
  - Pre-compaction

- \_\_\_F: Die Filling
- \_\_\_G: Hot Forming and Compacting  
Hot rolling
- \_\_\_H: Powder Forging
- \_\_\_I: Equipment Advances
  - \_\_\_Automated press systems
  - \_\_\_PM press systems
  - \_\_\_Process control
- \_\_\_J: Pore Free Consolidation
- \_\_\_K: Roll Compacting Clad strip
- \_\_\_L: PM Tooling & Design
- \_\_\_M: PM Extrusion
- \_\_\_N: Slip Casting
- \_\_\_O: Isostatic Pressing
  - \_\_\_Cold isostatic pressing
  - \_\_\_Hot isostatic pressing
  - \_\_\_Sinter/HIP process
- \_\_\_P: Non-Pressing Techniques for Powder  
Application Laser free-form fabrication
- \_\_\_Q: Semi-Solid Forming Superplastic  
forming
- \_\_\_R: Green Properties
- \_\_\_S: Other
  - \_\_\_Gelcasting
  - \_\_\_Metal/ceramic consolidation
  - \_\_\_Rotary forming
  - \_\_\_Warm compaction

#### IV. Powder Injection Molding (Metals & Ceramics)

- \_\_\_A: General
- \_\_\_B: Powders
  - \_\_\_Fine
- \_\_\_C: Binder Technology
  - \_\_\_Aqueous based binder
  - \_\_\_Low binder content
  - \_\_\_Preform design
- \_\_\_D: Sintering Technology
- \_\_\_E: Equipment Advances
- \_\_\_F: Process Automation
- \_\_\_G: Advanced PIM Materials
- \_\_\_H: New Products/Applications
- \_\_\_I: Design Criteria
- \_\_\_J: Debinding
- \_\_\_K: Size/Distortion Control
- \_\_\_L: Tooling Design
- \_\_\_M: Feedstock
- \_\_\_N: Green Properties
- \_\_\_O: Micro MIM

#### V. Pre-Sintering & Sintering

- \_\_\_A: General
  - \_\_\_Diffusion
  - \_\_\_Grain growth
  - \_\_\_Micro structure evolution
  - \_\_\_Phase change
  - \_\_\_Porosity
  - \_\_\_Recrystallization behavior
- \_\_\_B: Sintering Thermodynamics/Kinetics
  - \_\_\_Phosphorus steels
- \_\_\_C: Atmospheres - Control – Sintering
  - \_\_\_Carbon control

- \_\_\_Reducing/oxidizing  
\_\_\_17-4PH
- \_\_\_D: Furnaces
  - \_\_\_Belt
  - \_\_\_Fluidized beds
  - \_\_\_Lubricant removal
  - \_\_\_Pusher
  - \_\_\_Vacuum
- \_\_\_E: Processing Variables
  - \_\_\_Activated Sintering
  - \_\_\_Bimodal powders
  - \_\_\_Cyclic heating
  - \_\_\_Defects
  - \_\_\_Dimensional change/control
  - \_\_\_Dispersion hardening
  - \_\_\_Dispersion strengthening
  - \_\_\_Solid solution strengthening
  - \_\_\_Temperature variables
  - \_\_\_Thermal history
  - \_\_\_Thermal management
- \_\_\_F: Belt Materials
  - \_\_\_Ceramic belt
- \_\_\_G: Quality Control of Sintered Parts
  - \_\_\_CCT-diagram
  - \_\_\_Residual thermal stress
- \_\_\_H: High Temperature Sintering
- \_\_\_I: Liquid Phase Sintering
  - \_\_\_Transient liquid phase
  - \_\_\_Supersolidus liquid phase
- \_\_\_J: Sinter Hardening
- \_\_\_K: Solid State Sintering

#### VI. Secondary Operations

- \_\_\_A: General
- \_\_\_B: Joining
- \_\_\_C: Machinability
  - \_\_\_Non-metallic inclusions
- \_\_\_D: Machining Additives
  - \_\_\_Manganese sulfide
- \_\_\_E: Heat Treatment
- \_\_\_F: Steam Treating
  - \_\_\_Oxide coating
- \_\_\_G: Coatings
- \_\_\_H: Spray Coating
  - \_\_\_Plasma spraying
- \_\_\_I: Wear Resistant Coatings
  - \_\_\_Chemical vapor deposition
- \_\_\_J: Surface Hardening
- \_\_\_K: Carburizing
  - \_\_\_Plasma processing
- \_\_\_L: Nitriding
  - \_\_\_Ion nitriding
  - \_\_\_Nitrogen absorption
  - \_\_\_Nitrocarburizing
  - \_\_\_Plasma nitriding
- \_\_\_M: Lapping
- \_\_\_N: Other Secondary Operations
  - \_\_\_Corrosion protection
  - \_\_\_Plasma processing
  - \_\_\_Repressing
  - \_\_\_Ultrasonic cleaning
- \_\_\_O: Edge Preparation & Burr Removal

- \_\_\_P: Surface Modification & Densification
- \_\_\_Q: Copper Infiltration
- \_\_\_R: Surface Plating & Protection
- \_\_\_S: Brazing
  - \_\_\_Infiltration
- \_\_\_T: Welding
- \_\_\_U: Other
  - \_\_\_Surfactant degreasing

## VII. Materials

- \_\_\_A: General
- \_\_\_B: Iron & Steel
  - \_\_\_Alloy Steels
  - \_\_\_Amorphous, Iron based alloys
  - \_\_\_Boron alloys
  - \_\_\_Molybdenum steels
- \_\_\_C: Stainless Steel
  - \_\_\_300 series
  - \_\_\_400 series
- \_\_\_D: Tool Steels
  - \_\_\_Molybdenum alloys
- \_\_\_E: Reactive Metals (Zr, B, Be, Ta, Rh, Rare Earths, etc.)
- \_\_\_F: Aluminum, titanium, magnesium, and alloys
- \_\_\_G: Copper, Brass, Bronze and Alloys
  - \_\_\_Free-machining, unleaded
  - \_\_\_Friction materials
- \_\_\_H: Chromium, Nickel & Superalloys
  - \_\_\_Iron-nickel based alloys
  - \_\_\_Nickel based alloys
  - \_\_\_Cobalt base alloys
- \_\_\_I: Other
  - \_\_\_Magnetic
  - \_\_\_Shape memory alloys
  - \_\_\_Thermodynamic alloy development
- \_\_\_J: Additives

## VIII. Refractory Metals, Carbides &

### Ceramics

- \_\_\_A: General
  - \_\_\_Erosion resistance
- \_\_\_B: Tungsten Carbides
- \_\_\_C: Tungsten, Alloys & Composites
- \_\_\_D: Refractory Metal-Based Hard Materials
  - \_\_\_Binder phase
  - \_\_\_Cermet
- \_\_\_E: Microstructures/Processing/Properties
  - \_\_\_Hydrogen-reduction process
  - \_\_\_Porous material
- \_\_\_F: Ceramics
  - \_\_\_Coating
  - \_\_\_Powder
- \_\_\_G: Other
  - \_\_\_Boron carbide
  - \_\_\_Borides
  - \_\_\_Cemented carbides
  - \_\_\_Silicon nitride

## IX. Advanced Particulate Mat. & Processes

- \_\_\_A: General

- \_\_\_B: Composites
  - \_\_\_Carbon fiber reinforced
  - \_\_\_Composites
  - \_\_\_Continuous carbon fiber reinforced
  - \_\_\_Electrical materials
  - \_\_\_Environmental degradation
  - \_\_\_Vacuum hot pressing
- \_\_\_C: Intermetallics
  - \_\_\_Environmental degradation
- \_\_\_D: Consolidation
  - \_\_\_Metal matrix composites
  - \_\_\_Vacuum hot pressing
- \_\_\_E: Metal Fibers
- \_\_\_F: Thermal Spray Coating
- \_\_\_G: Nano Crystalline Materials
- \_\_\_H: Hybrid Packaging & Other Electronic Materials
- \_\_\_I: SHS-Self-Propagating High Temp. Synthesis
  - \_\_\_Ceramic superconductors
  - \_\_\_Hot consolidation
  - \_\_\_Iron aluminides
- \_\_\_J: Mechanical Alloying
  - \_\_\_Amorphization
  - \_\_\_Attritor milling
  - \_\_\_Mechanical alloyed surface
  - \_\_\_Oxide dispersion
- \_\_\_K: Functionally Graded Materials
- \_\_\_L: Rapid Solidification Technology
  - \_\_\_Laser melting
  - \_\_\_Laser welding
- \_\_\_M: Superconductors
- \_\_\_N: Light Weight Alloy Processing
- \_\_\_O: Energy Storage Materials
- \_\_\_P: Materials Exhibiting Unique Thermal Properties
  - \_\_\_Fullerenes (Bucky Balls)
- \_\_\_R: Advanced Magnetic Materials
- \_\_\_S: Metal Foams (Porous Open Cell Structures)
- \_\_\_T: Other
  - \_\_\_Combustion synthesis
  - \_\_\_Electronic packaging
  - \_\_\_Friction materials
  - \_\_\_High temperature strengthening

## X. Material Properties

- \_\_\_A: General
- \_\_\_B: High Density PM
- \_\_\_C: Wear Resistant Properties
  - \_\_\_Rolling contact fatigue
- \_\_\_D: Dynamic Properties -
  - \_\_\_Impact, Fatigue, Compressive Yield Properties
- \_\_\_E: Mechanical Properties
  - \_\_\_Density
  - \_\_\_Dual-phase steels
  - \_\_\_Ductility
  - \_\_\_Dynamic behavior
  - \_\_\_Fatigue
  - \_\_\_Fracture behavior
  - \_\_\_Fracture toughness

- \_\_\_ Hardenability
- \_\_\_ Hardness
- \_\_\_ Heat resistance
- \_\_\_ High strain rate
- \_\_\_ High temp. mechanical properties
- \_\_\_ Microstructural relationships
- \_\_\_ Permeability
- \_\_\_ Poisson's ratio
- \_\_\_ Porosity
- \_\_\_ Tensile properties
- \_\_\_ Transverse rupture strength
- \_\_\_ F: Corrosion Resistance
- \_\_\_ G: Magnetic Properties of PM Materials
- \_\_\_ H: Microstructures & Solidification Struct.
  - \_\_\_ Macroinclusions
- \_\_\_ I: Other
  - \_\_\_ Acoustic Emission
  - \_\_\_ Heat conductivity
  - \_\_\_ Powder properties
  - \_\_\_ Shape Memory Effect
  - \_\_\_ Superplasticity

#### **XI. Test & Evaluation**

- \_\_\_ A: General
- \_\_\_ B: Quality Management, Tools, ISO
  - \_\_\_ Attribute charts
  - \_\_\_ Certification
  - \_\_\_ Extensometer
  - \_\_\_ Plastic deformation
  - \_\_\_ Sensor technology
  - \_\_\_ Statistical process control
- \_\_\_ C: Corrosion Test Methods
- \_\_\_ D: Non-Destructive Evaluation Techniques
  - \_\_\_ Eddy current testing
  - \_\_\_ Resonant frequency testing
  - \_\_\_ Ultrasonic Testing
- \_\_\_ E: Measurement & Control
  - \_\_\_ Dimensional tolerances
  - \_\_\_ Green properties
  - \_\_\_ Strain gage
- \_\_\_ F: Manufacturing Accuracy & Reproducibility
  - \_\_\_ Material reliability
- \_\_\_ G: Testing Methodologies
  - \_\_\_ Compression testing
  - \_\_\_ Compression yield strength
  - \_\_\_ Differential temperature test
  - \_\_\_ Fatigue testing methods
  - \_\_\_ High temperature band test
  - \_\_\_ Machine test
  - \_\_\_ Wear resistant testing
- \_\_\_ H: Surface Finish Measurement,
  - \_\_\_ Micromechanical Property
  - \_\_\_ Measurements
  - \_\_\_ Microstructural preparation

- \_\_\_ Microstructural stability
- \_\_\_ I: Density Measurements
  - \_\_\_ Density variation
- \_\_\_ J: Crack Detection Methods & Prevention
  - \_\_\_ Infrared imaging
- \_\_\_ K: Metallography
  - \_\_\_ Crystal structures
  - \_\_\_ Grain boundary segregation
  - \_\_\_ Segregation
  - \_\_\_ Tensile fracture surface
- \_\_\_ L: Standards
  - \_\_\_ Safety
  - \_\_\_ Test
  - \_\_\_ Structural Parts
  - \_\_\_ Bearings
  - \_\_\_ Metal Injection molding
- \_\_\_ M: Other
  - \_\_\_ Alloy Development
  - \_\_\_ Deformation behavior
  - \_\_\_ Deformation textures
  - \_\_\_ High speed visualization
  - \_\_\_ Image analysis

#### **XII. Applications**

- \_\_\_ A: General
  - \_\_\_ PM parts
- \_\_\_ B: Gears
  - \_\_\_ PM Steels
  - \_\_\_ Noise level
  - \_\_\_ Carbides
- \_\_\_ C: Sintered Bearings & Filters
- \_\_\_ D: Cutting Tools & Abrasives
- \_\_\_ E: Other
  - \_\_\_ Aerospace
  - \_\_\_ Automotive
  - \_\_\_ Electrical materials
  - \_\_\_ Porous materials
  - \_\_\_ Valve train

#### **XIII. - Management Issues**

- \_\_\_ A: General
  - \_\_\_ Automotive industry
  - \_\_\_ Continuous improvement
  - \_\_\_ Manufacturing control
  - \_\_\_ State of the industry
- \_\_\_ B: Health, Safety & Environmental Issues
- \_\_\_ C: Cost Benefits of New Equipment
- \_\_\_ D: Statistics of PM Parts Behavior
- \_\_\_ E: Concurrent Engineering/JIT
- \_\_\_ F: Intelligent Processing of Materials
- \_\_\_ G: Economics of PM
- \_\_\_ H: Conversion Processes/Dual-Use Technology
- \_\_\_ I: Marketing, Analysis & Trends

**Return this form in its entirety along with your completed manuscript by the Final Manuscript Deadline:**

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 Metal Powder Industries Federation  
 105 College Road East, Princeton, NJ 08540  
 email: [paper@mpif.org](mailto:paper@mpif.org) Fax: (609) 987-8523 Phone: (609) 452-7700