SPARK PLASMA SINTERING EQUIPMENT

P^2C- Plasma Pressure Consolidation Process

Think More…Make More…Test More…Quickly & Effectively

SPS-P^2C-200

Designed and Built By Materials Scientists to Develop and Optimize Novel Engineered Materials

The time proven, award winning P^2C-200 plasma sintering equipment, with its superior process profiling technology, and large part capacity, can be in your facility tomorrow, delivering next-in-class materials allowing the realization of your most challenging and dynamic materials engineering and research ideas

- **SAFETY 1st—The SPS-P2C-200 is fully interlocked to prevent operation if any of the press's safety features are not engaged**
- **VERSATILITY and ACCESSABILITY—The main vacuum bell chamber offers a 20" (50 cm) tall open height and 40" (100 cm) diameter chamber for easy die placement and retrieval. Press controls are forward mounted, and the vacuum chamber assembly can be removed and realigned without disassembling the press**
- **VACUUM CHAMBER—Water cooled, split-bell chamber allows continuous operation at temperatures up to 2,500 °C. A generous 6" (15 cm) working diameter blanked port provides ample area for supplemental gas or in-chamber processing options**
- **PRESS FRAME—Rugged Box-Frame construction supporting 9" (22.5 cm) diameter press rams, allowing application of up to 200 tons (0 to 1,993 kN) of force, ideal for large-part scale up. The press frame is raised/lowered by side mounted screw jacks**
- **HYDRAULICS and MONITORING—10,000 psig system designed to give research personnel maximum flexibility to establish and refine new materials processing requirements. System includes a manually controlled electric hydraulic pump and unit mounted pressure gauge. The consolidation progress is monitored by the cylinder ram position read out having 0.01 mm (0.0004") accuracy, and a "zeroing" feature for variable die heights**
- **SCR POWER PROFILING—Water cooled, 100% duty cycle, tandem operated, Silicon Diode Controlled Rectifiers—30,000-50,000 total Amperes @ 27 Volts of forward DC output. The power supplies can be either voltage or amperage controlled, via programmable laptop based process profiling software. The straight DC power can be further augmented with simultaneous, user controlled, variable pulsing. Power bus cables are water**

The Patented SPS-P^2C-200 Equipment Is Designed and Refined by Materials Scientists, Specifically To Support the Development of Leading Edge Engineered Materials

Materials Modification, Inc. | 2809-K Merrilee Dr. | Fairfax, Virginia | 703-560-1371 | www.matmod.com

SPARK PLASMA SINTERING EQUIPMENT

P^2C- Plasma Pressure Consolidation Process

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SPS-P^2C-200 is a production-proven system for the development and optimization of novel engineered materials with innovative performance properties

- **Metals—Fe, Ni, Cu, Al, Co, Re, W, Mo, Ta, Ti, Mg, NiAl, TiAl**
- **Ceramics—SiC, B_4C, ZrO_2, TiB_2, HfB_2, ZrB_2, $Y_3Fe_5O_{12}$, TiC, WC, $Y_3Al_5O_{12}$, MgB_2, CaF_2, MgF_2, MoS_2**
- **Composites—TiB_2-Al_2O_3, TiB_2-ZrO_2, TiB_2-B_4C, SiC-B_4C, WC-Co, Mo-Cu, W-Cu, C-Cu, HfC-TaC, ZrC-B_4C**
- **Multilayered Materials—Up to 5 layers of differing functional properties**
- **Unconventional Structures—Nano-Carbon and Layered Composites | Porous Materials | Joining of Dissimilar Materials**

Who are we? Materials Modification Inc. (MMI) was founded in 1986—www.matmod.com

- **Dynamic applications driven Development Company within the areas of materials science**
- **Cutting-edge research and development programs for private industry and government**
- **Pioneer in the field of nanomaterials and coatings technology**
- **33 patents covering novel materials, equipment, nano applications and coatings**

Our Product—SPS-P^2C process consolidation technology is specifically designed to unlocking the high performance promises suggested by submicron and nano-scale science and materials engineering.

- **Plasma Pressure Compaction can consolidate nano, submicron and micron particulate blends**
- **SPS-P^2C processing offers significant economic and physical performance improvements over traditional hot pressed and sintered ceramics and powders.**

The Innovative Solution—SPS-P^2C Leaps Beyond Conventional Hot Pressing and Sintering

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- **Predictable Uniformity—Ability to start consolidation with nano-scale materials and end with nano crystalline grain structure**
- **Greater final material purity—No binders, No cementation/alloying agents, Low/No unprocessed reactants**
- **One-Step in-situ compaction, plus rapid uniform plasma heating for maximum densification and control over grain structure**
- **Maximum theoretical densities, exclusive preprocess cleaning and out gassing of particulate surface contaminants for excellent inter-particle fusion**
- **Low-temp/high thermal energy sintering yields fast-cycle consolidation—minutes vs. hours.**

Answering Challenges of High Purity, Wear, Heat and Corrosion in Typical Commercial Applications

Unrestricted R&D engineering with submicron/nano-scale metallic, ceramic and hybrid materials, new classes of bi-metal, ceramic/metal laminations, multi-material matrix/composites

Custom Nano and Sub-Micron Sputtering Targets | Super Performance Seals and Bearings | Oil and Gas Well Drilling Components | Tube/Wire Drawing and Extrusion Die Inserts | Hot and Cold Forming Punches | Carbides for Wire EDM | Large Cutting Inserts | Brake Materials | Wire and Mandrel Tube Preforms

Broad Government and Commercial Market Segments

Metals, ceramics or hybrids designed for applications in land, sea, air and space defense, medical and industrial markets where low/no downtime are crucial considerations.

High Temperature Mirrors | IR Windows | Lightweight Body Armor Inserts | Exterior and Interior Vehicular Armor | Fixed and Rotary Wing Aircraft Cockpit Armor | General R&D and Engineering Development of Ceramic, Metallic, and Functionally Gradient Materials | Refractory Metal Substrates

US Patents: 5,989,487 | 6,001,304 | 6,183,690 B1 | 6,187,087 B1 | 6,309,591 B1 | International Patents: AU: 752326 | IN: 197635

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