About PLASMATERIALS, INC.

Plasmartials, Inc. was established in 1987 to service the needs of the thin film industry by supplying a diversified line of high purity deposition materials, and related services to scientists and engineers in the research and development community.

Since then, we have expanded this capability to include all sectors of the thin film industry. Through an extensive manufacturing and supply network, Plasmartials, Inc. produces and markets a full range of products for R&D, pilot and full scale production. Materials for such diverse applications as Architectural Glass, Microelectronics, Display Technology, Transparent Conductive Coating, Packaging and Decorative Coatings to name a few, are all produced to exact specifications.

Plasmartials, Inc. is a leader in providing high purity materials for all types of thin film applications. Whether the requirement is for large area, single piece, enhanced design, base metal alloys for architectural glass coating or high purity semiconductor alloys, Plasmartials can provide state-of-the-art materials to meet the most demanding needs.

THE THIN FILM INDUSTRY

Physical Vapor Deposition or PVD has become an established commercial process for manufacturing all types of thin film products. Whether through a momentum transfer of charged ions to individual atoms (sputtering) or a direct transfer of amplified light to a material target (laser ablation), a collimated source of accelerated focused ion beam bombardment directly to a material target (ion deposition) or thermal transfer (evaporation) resultant films can be deposited on selective substrates to produce products which are technologically advanced, less expensive, easier to fabricate, lighter in weight and more refined than their bulk material counterparts.

Through PVD, virtually every element, alloy, composite or refractory material can be transformed from bulk to thin film form. These processes and products span a wide range of commercial industries as well as playing a leading role in material and technology development. Plasmartials, Inc. offers these materials in many different forms including evaporation pellets, wire, powder, electron beam starter sources or sputtering targets.

As a worldwide manufacture and marketer of specialty materials for use in the thin film Industry, Plasmartials, Inc. offers a diversified range of products that span from ceramics, metals, and elemental forms for use in R&D, pilot and full-scale production. Most materials can be fabricated in specific geometries to fit all commercially available, as well as custom designed systems. These products include ceramics, nitrides, carbides, oxides, refractories, zone refined materials, ferrous, non-ferrous and precious metals.
OUR EXPERTISE

**Powder Metallurgy**
In the past several years, Plasmaterials, Inc. has developed a variety of metallurgical processes to service the product requirements of the Thin Film Industry. This technology includes hot pressing, cold isostatic pressing or “CIPing”, vacuum sintering, hot isostatic pressing or “HIPing” for refractory ceramics, (oxides, nitrides, borides, sulfides, selenides, tellurides, carbides, etc.) as well as composite materials.

These technologies are often blended with other fabrication procedures to provide superior PVD products. Grain reduction, densification, purification and blending are just a few of the metallurgical processes and parameters designed into the products produced by Plasmaterials Inc..

**Vacuum Melting & Casting**
Plasmaterials, Inc. employs a number of different techniques to produce metal and metal alloy materials. Depending upon temperature ranges required and physical properties of the constituents; materials are either vacuum arc melted or electron-beam melted. These materials are further processed through zone refining for purification and then fabricated into the desired shape or form.

**Plasma Spraying**
Plasmaterials, Inc. has been innovative in developing the technology to plasma spray materials directly onto cooling plates for both planar and rotary sputtering applications.

A new generation of materials can now be supplied which previously had been impossible to fabricate. Nonequilibrium alloys, phase pure composite, amorphous materials and supersaturated solutions can be supplied on backing plates and tubes to help create the next generation of thin film development.

OUR TECHNOLOGY

**Analytical Capability**
Purity and composition are constantly monitored on all materials being produced. Various testing resources include Glow Discharge Mass Spectrometry (GDMS) and Secondary Ion Mass Spectrometry (SIMS) for bulk material analysis. Additionally, surface morphology and subsurface analysis can be evaluated utilizing AUGER-ESCA and Microprobe testing. The result is that compositional integrity, as well as consistency and homogeneity are maintained for each target or evaporation source.

**Advanced Engineering**
Plasmaterials, Inc. strives to be technically innovative in all forms of material fabrication. New materials and processes are constantly being developed to meet the needs of an ever-changing industry.

Plasmaterials, Inc. has developed a large range of fabrication techniques. Materials can be formed or shaped into unique contours for enhanced designs, rotary targets and evaporation charges, etc..

**Material Development**
Through our technological development, all phases of material characterization can be accomplished. The properties of a metal or compound can be accurately determined through the use of qualitative and quantitative analytical techniques. This approach is especially helpful in developing new materials for specific applications or refining current materials to meet tighter quality requirements.

**Quality Control**
All aspects of PVD material production are rigidly controlled at Plasmaterials, Inc. through computer assisted tracking and analysis. From incoming raw material to final product, a database system insures absolute adherence to strict quality standards. This guarantees initial quality and enables absolute reproducibility of product consistency for long-term production applications in an ever-demanding industry.
About OUR SPUTTERING TARGETS

Plasmaterials, Inc., worldwide manufacturer and marketer of special materials for the use in industry, manufactures and supplies high quality products specifically designed for the vacuum industry. Plasmaterials has thirty-five years of experience in the development of process technology using state-of-the-art techniques and equipment to refine, fabricate and process high purity vacuum deposition materials. Plasmaterials offers high purity sputtering targets, powders, granules, shot, wire and bar stock of nearly every element on the periodic table including alloys and compounds.

Plasmaterials offers a complete line of sputtering targets ranging from commercial grade to highest purity, zone refined Ultra-Pure grade. These materials can be fabricated to fit all commercially available systems or to specific dimensions required or your particular applications. A number of metallurgy techniques are employed in PVD material fabrication.

Enhanced Design

Plasmaterials, Inc.'s unique enhanced design sputtering targets are produced for use in the sputtering of precious metals and magnetic materials, thereby increasing target utilization. Through engineering design, the enhanced profile provides utilization factors far in excess of those conventionally found in planar designed targets.

By taking the inverse of the erosion profile, thus increasing the target thickness in this area, Plasmaterials has developed long life targets with utilization approaching 100% and with longevity almost twice that of ordinary planar targets. These targets have increased volumes in the area of greatest wear and decreased volumes in areas where little or no deposition takes place. This unique capability is available for both planar and rotary designed cathode assemblies.

Rotary

Plasmaterials, Inc. has developed a complete line of rotary cathode sputtering targets. Materials are either continuously cast, extruded, HIP'ed or plasma sprayed to provide technological advances in rotary design. In addition, unique profiles can be developed for specific applications to provide targets for better wear characterization, longer life, unique physical characteristics or altered metallurgical properties.

Precious Metals

Plasmaterials, Inc. offers a full range of precious metal physical vapor deposition materials. They include gold, silver, platinum, palladium and iridium based metals, alloys and composite materials. Most are available in a variety of purity levels ranging from commercial to Ultra-Pure grades. Special alloying and fabricating techniques have been developed to provide homogeneous materials which exhibit an extremely high density and fine grain structure.
**Sputtering Targets and Evaporation Materials.**

- Hot Pressing
- Hot Isostatic Pressing (HIP'ing)
- Cold Isostatic Pressing (CIP'ing)
- Vacuum Sintering
- Induction Melting
- Vacuum Melting & Casting
- Arc Melting
- Electron-Beam Melting
- Plasma Spraying
- Co-Precipitation

**Evaporation Materials**

Plasmaterials can provide electron-beam starter sources, granules, slugs, wire or powders for all standard evaporation systems. Whether your requirements are for resistance evaporation systems with pre-weighed charges or for continuous feed multi-source E-beam evaporators, Plasmaterials can meet your material requirements. Crucible liners are available in a variety of material compositions, including intermetallics and refractories, to ensure the purest possible resultant films. Contact your Plasmaterials Sales Engineer or Representative for assistance in selecting the best liner composition for your application.

**Backing Plates**

Plasmaterials manufactures backing plates for nearly all conventional sputtering systems and can also custom design special assemblies. Whether you require OFE copper, stainless steel, molybdenum or aluminum, Plasmaterials can provide the dimensional tolerances to fit your needs. All backing plates are fabricated on numerically controlled equipment to further ensure absolute reproducibility.

**Bonding Services**

Plasmaterials provides all metal bonding to affix sputtering targets to backing plates for systems which do not utilize a bolt-on target assembly. This proprietary process utilizes layers of low vapor pressure metals which have been applied to both the backing plate and the target and are then diffusion bonded together. This bond not only provides the necessary mechanical strength required to hold the two materials together, but it also provides a high thermally and electrically conductive layer for transfer of heat and electricity from the backing plate to the target. In addition, this material provides a differential slip plane to allow for differences in thermal expansion between the target and the backing plate. This prevents the target from debonding or cracking during the heat up and cool down cycle of the plasma deposition process.
About OUR BACKING PLATES

PLANAR
Plasmaterials, Inc., manufactures a complete line of backing plates for almost every commercially available sputtering, cathodic arc, ion deposition and laser beam ablation system. Additionally, custom backing plates can be designed, engineered and manufactured for non-conventional or in-house designed deposition systems.

Most backing plate material requirements need high thermal and electrical conductivity, tight geometrical tolerance, non-corrosivity and good durability. The typical material of choice is OFE copper, however, the target material characteristics may dictate the need for other materials such as molybdenum, stainless steel or aluminum. These are all available from Plasmaterials, in standard as well as custom designs.

In all cases, the backing plates are manufactured on numerically controlled (NC) equipment to OEM specifications guaranteeing the required dimensional tolerances and absolute reproducibility. Special coatings of chromium or nickel are also available in situations in which some target material characteristics may cause a problem in connection with the backing plate base metal.

ROTATABLE
Back ing tubes are also available for rotatable cathode assemblies. These tubes are available in stainless steel, copper, aluminum and titanium, as well as specialty materials and alloys depending on the sputtering target material to be applied. These backing tubes are available for all commercial rotatable systems, post-magnetron, or for any special design requirements you may have.

To guarantee absolute concentricity, starting materials are extruded from high temperature furnaces to a near net shape configuration. This seamless tube is then finish machined to specific tolerances in order to meet the most exacting requirements. Specific attention is paid to sealing surfaces, I.D. and O.D., wall thickness and straightness, as well as total indicated run out (TIR). These products are designed for long life and can be refurbished numerous times prior to reapplication of target materials.
About PLASMA SPRAYING

Plasma Spraying
Since its development in the early 1900's, thermal spraying of various materials (primarily metals) was limited to coating applications with relatively low melting temperatures. Typically, these applications involved wear and corrosive coatings, parts refurbishing and other protective coatings. The advent of the space age in the mid-50's pushed this technology to higher temperatures and greater limits as the need for higher performance materials was created. This led to the development of plasma arc spraying (PAS) and a wider range of capabilities. More recently, PAS has extended these capabilities to higher flame temperatures. This new plasma technology provides a working range of up to 28,000°K, creating exciting new possibilities. Materials, such as ceramics, carbides, silicides, nitrides, cermets and others can easily be plasma arc spray processed for use in target material production.

Plasmaterials, Inc. has further refined this technology to create an entire new line of previously unobtainable materials for use in the physical vapor deposition (PVD) industry. Whether for thermal evaporation materials, sputtering targets, or electron-beam crucible liners, the PAS technology has allowed us to create a broad, new range of materials beyond the range of conventional fabrication techniques. This technology is especially advantageous for creating enhanced design magnetic planar targets, rotatable ceramic targets and other complex geometries.

PAS can be used to generate composite materials for sputtering target applications by either directly spraying onto a backing plate, a mandrel, or, alternatively, onto a removable substrate for stand alone applications. These sprayed materials can be supplied in thicknesses ranging from ultra thin R&D applications to those used for production coating, including materials up to one inch thick and fifteen feet long. In most cases, these materials are high purity, homogeneous, ultra fine grained and extremely high in density. This makes them ideally suited for use in PVD applications.

All equipment is numerically controlled (NC), guaranteeing absolute reproducibility from both run-to-run and lot-to-lot. This includes all material feed systems, process control parameters and “XYZ” source transport systems. This control process can be optimized for each unique application from start to finish.

Our success in creating multi-constituent alloyed materials of complex geometrical design is only limited by the creativity and demands of our customers. To date, our developing family of materials has found use in anti-reflective coatings, display technology, reflective and decorative coatings, architectural glass, optical coating applications, photovoltaics and more.

So if your needs extend beyond the conventional wisdom dictated by standard metallurgical, it may be time to give Plasmaterials a call and find out how we can help put PAS technology to work for you. Our sales engineers and research group will work with you in developing your product needs.
About OUR BONDING

**Bonding**
Plasmaterials, Inc. provides all metal bonding to affix sputtering targets to backing plates for systems which do not utilize a bolt-on target assembly. These targets can range from elemental metals to oxides, nitrides, carbides, fluorides, compounds, refractories, ceramics, intermetallics, etc., including any combination thereof. Backing plates are typically produced from OFE copper, non-magnetic stainless steel (316 or 304), molybdenum or aluminum. The purpose of the bonding is to provide the following functions during plasma deposition:

- **Mechanical Strength**
- **Electrical Conductivity**
- **Thermal Conductivity**

**This proprietary process** utilizes a series of thin metallic layers to provide adhesion, diffusion barrier and wetting layers to the target and backing plates. These elemental materials are highly conductive low vapor pressure materials which are coated on an atomic level. Each layer is specifically designed, engineered and applied utilizing state-of-the-art technologies in order to guarantee the quality of each process step, as well as absolute reproducibility from target-to-target.

After the application of this thin film composite, a specially designed solder is used to bond the target to the backing plate. Plasmaterials utilizes different materials for each target/backing plate combination. Depending on the target characterization and backing plate material, a specific solder is chosen to optimize the bond. Particular attention is paid to the difference between the thermal coefficient of expansion of the target and the backing plate in conjunction with the ductility of the target.

**During sputtering**, the target surface is bombarded with high energy ions. The momentum transfer which results from the collision causes the individual atomic bonds on the target surface to be broken. In turn, the exothermic reaction results in a tremendous heat buildup on the target surface which must be dissipated. Typically, this is accomplished through direct water cooling of the backing plate configured within the cathode assembly. By metallically bonding the target directly to the backing plate, a direct link is provided to dissipate the heat from the target surface to the water cooling.

Sputtering targets metallically bonded to OFE copper backing plates
Reclamation

Plasmaterials offers a reclamation program for all precious metal materials, including certain base metals, i.e., indium, indium alloys and oxides. Further details regarding this program and reclamation schedules can be obtained by contacting your Plasmaterials Sales Engineer or Representative.

Quality Control

All materials provided by Plasmaterials are furnished with a Certificate of Analysis stipulating exact purity and trace elements present in the product. Through state-of-the-art analytical and diagnostic equipment, our engineering technicians monitor material properties during individual processing. To ensure absolute quality, consistency and purity, our analytical capabilities include:

- Wet Chemistry
- Emission Spectroscopy
- Direct-Coupled Plasma Spectrometry
- Atomic Absorption Spectrometry
- Scanning Electron Microscopy
- X-ray Diffraction
Plasmaterials, Inc., strives to be technically innovative in all forms of material fabrication. New materials and processes are constantly being developed to meet the needs of an ever-changing industry.

To learn more about us, visit us at:

WWW.PLASMATERIALS.COM