

# MATERIALS SCIENCE, INC.

## Vacuum & Thin Film Technology

### POLARIS™ GEN II

#### 2 & 3 Inch Round Sputtering Sources for Research, Development & Prototype Production

#### Industrial Performance in a Small Size

■ Ideal for Reactive and Low Pressure Operation in Oxygen Environment. No Materials of Construction like Aluminum That Oxidize & Create Arcing.

■ Stable Operation at Very Low Powers & Rates.

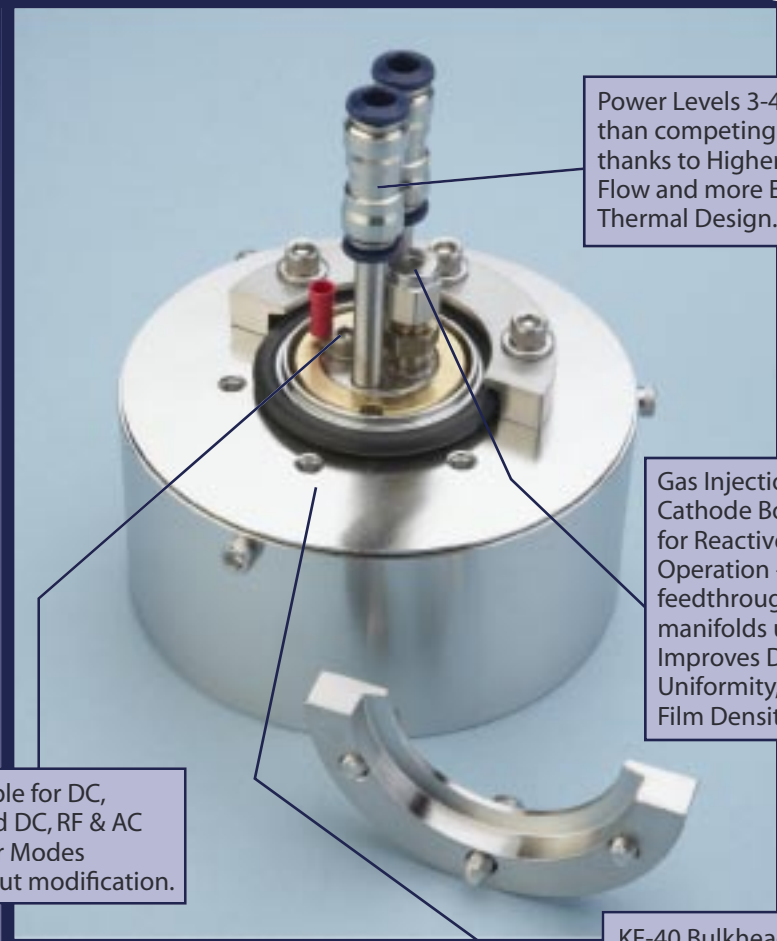
■ Tilt Mechanism, Variable Positioning, Shutters & Feedthrough Adaptors Among Standard Options – Custom Designs Available.

■ Bonded, Clamped and Directly Cooled Targets.

■ “Unbalanced” Magnet Arrays & Magnet Modules for Magnetic Materials are Available.



UHV precision cleaning results in low base pressure, Clean, Dense films.



Power Levels 3-4 x Higher than competing designs thanks to Higher Water Flow and more Efficient Thermal Design.

Gas Injection Through Cathode Body – Ideal for Reactive &  $10^{-4}$  Torr Operation – Additional feedthroughs & manifolds unnecessary. Improves Distribution Uniformity, Adhesion & Film Density.

Suitable for DC, Pulsed DC, RF & AC Power Modes without modification.

All Utility Connections are made at Atmosphere.



Modular Design makes it easy to install in virtually any system.

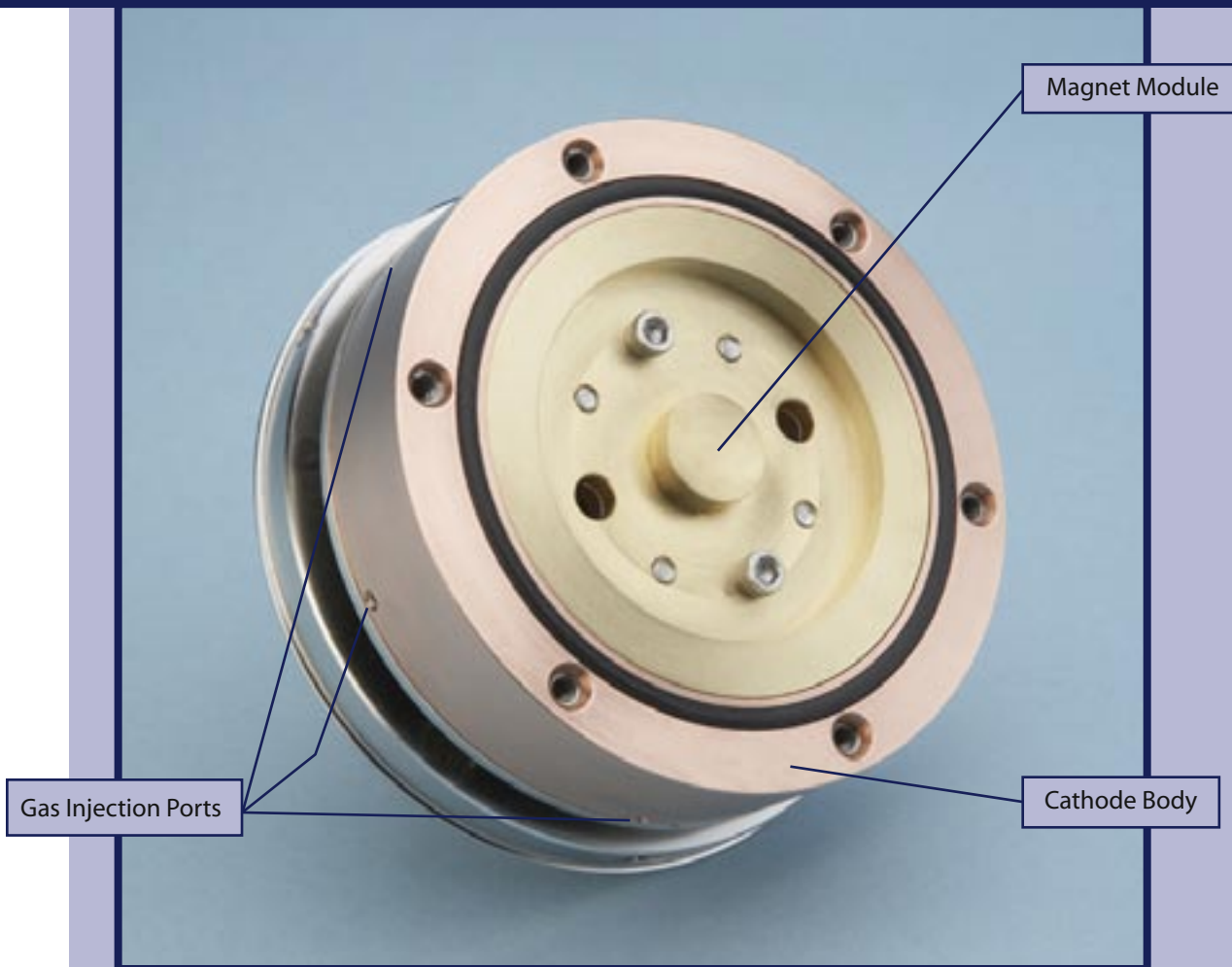
KF-40 Bulkhead Flange connects to Standard Feedthrough Packages or users can make Inexpensive Custom Feedthrough Arrangements using commercially available vacuum hardware.

#### What Makes Polaris™ Sources Different?

Polaris™ sources provide industrial robustness and performance in a small research package. They can operate stably at low  $10^{-4}$  torr background pressures at very low power levels. Conversely, because cooling water flow rates through the sources are nearly 2.5x that of competing sources, extremely high power levels can be achieved using directly water cooled targets during long process runs and pre-commercial development efforts.

#### Good Vacuum Practice

It's unlikely that you will consider fastener sizes when selecting a small sputtering source. We do. Small diameter fasteners gall more easily in vacuum and seize. We use larger, coarse thread screws. Threaded connections in vacuum—especially those exposed to heat and redeposited material, whether on target clamps or “adjustable” ground/anode shields are a bad idea. Not being able to exchange a target or



Gas flowing through the cathode body and efficient electron confinement enable long source-to-substrate distances at pressures in the  $10^{-4}$  torr region.

having to use a hammer to service the source when conducting a critical experiment suddenly becomes a big issue not previously contemplated.

### Simple, Compact & Reliable

Most sources are installed in relatively small chambers, so compactness is important. Adding gas manifolds, "chimneys" and other optional features increases size, expense and complexity. O-ring sealed, push-to-connect water fittings eliminate water leakage, especially when the cooling lines have a tight radius. The stainless steel water line tubes are easily replaced if damaged. Ultem insulators ensure that all types of power supplies can be used, and that the insulators won't crack, arc or cold flow. Stainless steel anode/ground shields and KF-40 bulkhead clamps eliminate arcing caused by native oxide growth, especially in the presence of other plasma and ion sources that aren't sufficiently neutralized. All parts exposed to vacuum are UHV precision cleaned or electropolished.

### Better Process Control

Because gas is injected through Polaris™ cathode bodies, process benefits are obtained (stable, low

pressure operation, reduced insulating film growth and backscattered material on the target surface –reduced arcing, denser films, better control of stoichiometry, etc.) and the source stays small. Process geometry variability becomes limited the bigger the source in small chambers. Target material is deposited on manifolds, chimneys, shields and flakes off—causing arcing, shorting and other bad stuff. The less surface area, the better. When gas distributors/manifolds sold by our competitors are connected through the chamber wall at ground potential, the probability that the plasma will be disturbed increases (non-uniform films), rates drop and base pressures increase (lower ionization efficiency because electrons will more likely follow the ground path instead of remaining present in the plasma discharge).

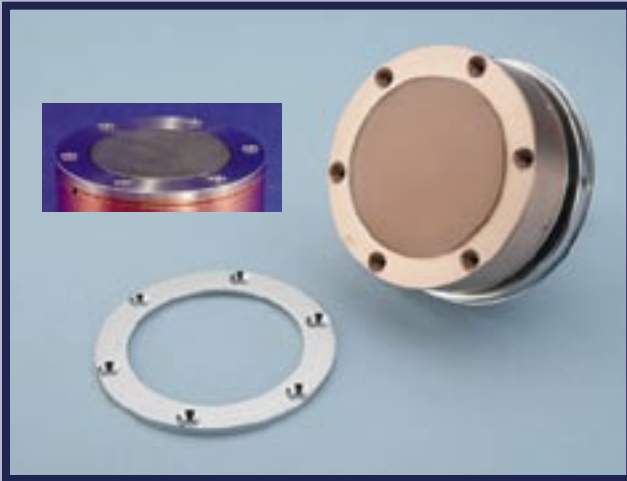
### A Lasting Investment

Polaris™ sources emphasize a robust design, reliability, ease of maintenance and low cost of ownership. We think you don't get good value for money if the purchase price is low, but the cost of maintenance is high and reliability low. The use of welded and brazed assemblies lowers the

manufacturing cost, but doesn't consider how difficult it makes the source to clean and service. Aluminum erodes easily when vapor honed, grit blasted or, in most cases, chemically cleaned. A brazed insulator assembly or a feedthrough with a bellows welded to it experiencing a vacuum

leak is an expensive repair. Every component in Polaris™ sources subjected to normal operation can be serviced or replaced by the user on site using, in most cases, commercially available parts and hardware.

## Target Mounting

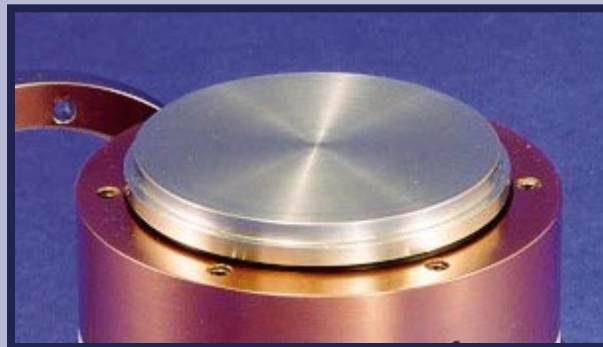


Bonded Target

Targets may be bonded, clamped or directly water-cooled, depending upon the target material, user preference and power level. Brittle, soft and low thermal conductivity materials should be bonded to the backing plate. This minimizes hot spots, insulating film growth and permits much higher power levels and rates of deposition compared to clamped targets. Targets can be clamped to a semi-permanent backing plate that remains attached to the cathode body. This method is appropriate only when low power levels are used for short duration. Directly water-cooled targets are recommended for high power/high rate sputtering of mechanically strong materials like refractory metals.



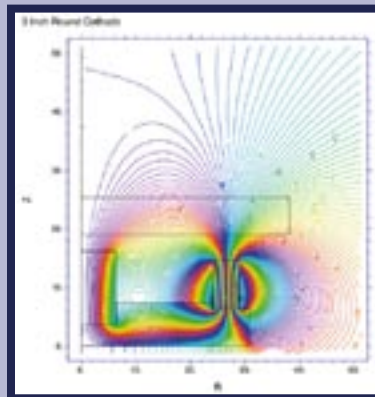
Clamped Target Arrangement



Directly Water-Cooled Target

## Magnetics

The magnet module resides in the cooling water cavity, ensuring maximum protection from overheating. The discrete magnets within the module are completely encapsulated and are protected from exposure to water. Polaris™ sources are supplied with a balanced magnet array as standard. Custom arrays for "unbalanced" magnetron sputtering and for sputtering magnetic materials can also be supplied. These arrays require a discussion with the customer about materials, process and expectations.



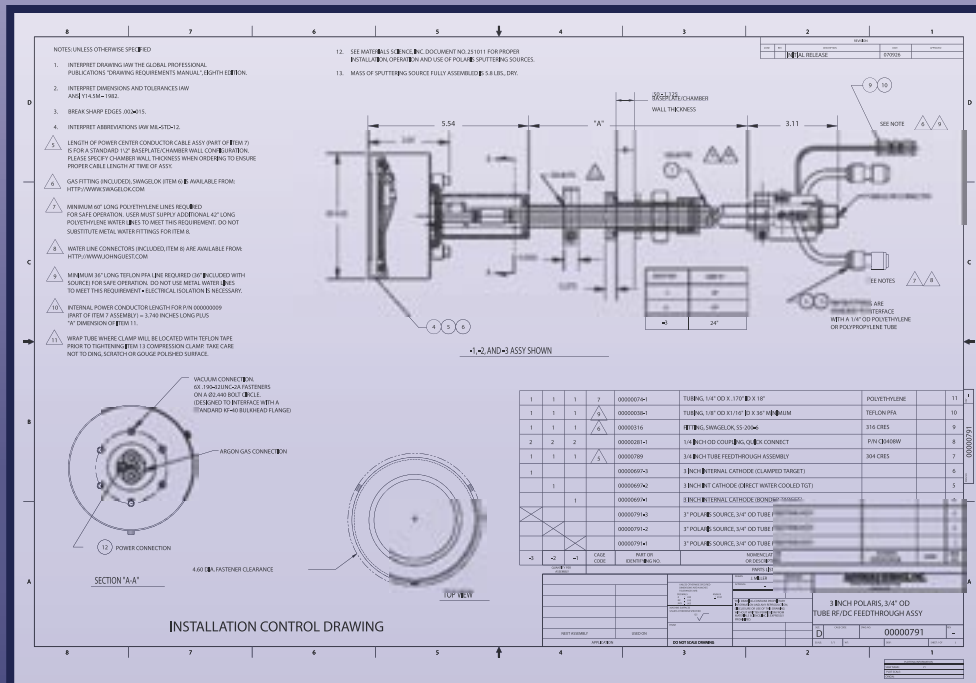
Finite Element Analysis software is used to optimize performance for specific applications.

## Installation & Feedthroughs

The basic sputtering source has a KF-40 bulkhead flange. Power, water and gas connections are made at atmosphere within it. A variety of standard feedthrough kits mating with this flange are offered, such as the typical examples shown. Users having other system configurations may adapt from this flange using standard, commercially available vacuum hardware.



KF-40 to 1" Baseplate Feedthrough RF/DC Feedthrough Kit



Adjustable Position  
1" Baseplate RF/DC  
Feedthrough Assembly

*Complete, accurate, up-to-date documentation is available for download from our web site.*

*We also still like to speak to our customers when they call for assistance. Let us know if you need additional information or assistance.*



Pay for your Polaris™ source with a purchase order, wire transfer or credit card.



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Visit our Web Site: [www.msi-pse.com](http://www.msi-pse.com) for CAD drawing blocks, complete specifications, performance data, ordering information, drawings and dimensions, backing plate and target fabrication data.

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