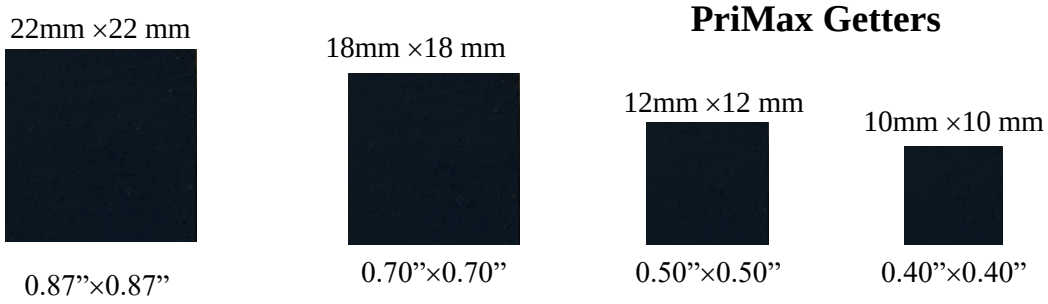
NANOFEA

NANOMAX
Getters Reimagined

PriMax Getters
(Vacuum Systems/Optic/MEMS/Hermetically Sealed Packages)



NanoFEA (Nano Functional Engineering Atmospheres) has designed and developed a series of multifunctional nanomaterials for absorbing various gases and organic VOCs. These hierarchically porous nanostructured materials are specifically designed to absorb harmful polar gases (e.g., H_2O, CO_2, CO, NH_3, and SO_2) and non-polar gases (e.g., H_2, O_2, N_2, CH_4, and SiH_4). They are intended for use in demanding and challenging vacuum equipment and hermetic packaging systems, where the prime polar and non-polar gases outgassing are highly concerned.

Hierarchically porous nanostructured materials provide a novel method for gas absorption in vacuum equipment. These harmful gases can degrade vacuum equipment and hermetic packaging systems, as well as compromise long-term reliability. PriMax multifunctional gas absorption getters offer a cost-effective solution, with an adsorption capacity of up to ~18 wt% for polar gases (e.g., H_2O, CO_2, CO, NH_3, SO_2 etc.) and ~30 wt% for non-polar gases (e.g., H_2, O_2, N_2, CH_4, and SiH_4). NanoMax material based getters offer a cost-effective solution, which has been patented as disclosed in US Patent Application# 2025/0073666 A1 and 2025/0091030 A1.

Designed and produced by NanoFEA, PriMax hierarchically porous nanostructured materials represent a new generation of products for efficiently absorbing various emitted gases in multifunctional vacuum equipment. By absorbing harmful gases, they prevent potential performance degradation and ensure high reliability throughout the 20-year lifespan of vacuum equipment and hermetic packaging systems.

Benefits of PriMax getters

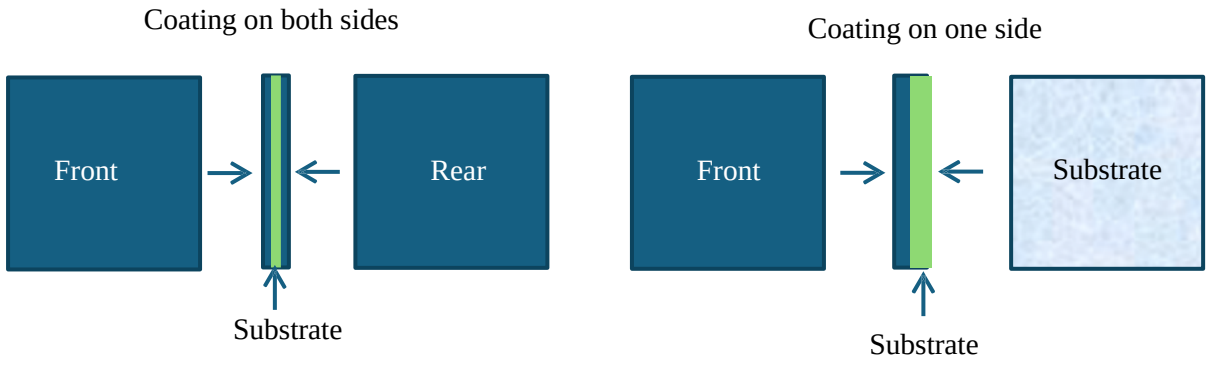
- Capable of absorbing polar gases (e.g., H_2O, CO_2, CO, NH_3, SO_2, NO, NO_2, HCl, and HF)
- Capable of absorbing non-polar gases (e.g., H_2, O_2, N_2, CH_4, and SiH_4).
- Absorbs moisture/water vapor capacity from 10wt% to 20 wt%.
- Various Sizes: Offers standard and custom sizes to fit any packaging requirement.
- Lightweight and Low Profile: Ensures excellent performance without adding bulk.
- Easy Application: Can be applied to any surface using high-temperature adhesive films or epoxy resins of your choice.
- Wide Temperature Range: Functions efficiently from -55°C to +300°C.
- No Activation Required: Ready to use without activation or regeneration.
- Long Shelf Life: Maintains effectiveness for up to 2 years from the date of purchase.

sales@nanofea.com +1 (720) 703-4266
www.nanofea.com

NANOFEA

NANOMAX
Getters Reimagined

PriMax Getters
(Vacuum Systems/Optic/MEMS/Hermetically Sealed Packages)



Getter Color: Gray to off-white, light black, and black

Substrate materials: Borosilicate glass, silicate glass, Alumina (92-99%), Metal (Ti, Cu, Kovar, and All-alloy)

Getter Physical Properties:

Density: 1.10±0.05 g/cm³
Dielectric constant: 3±1
Thermal conductivity: 0.15±0.25 W/m·K
Coefficient of thermal expansion (CTE): 8±4 ppm/°C
Young's modulus: 0.1±1.0 GPa
Electric Insulation resistance: 10^{10} – 10^{12} Ω·cm
Surface energy: 35-45 mJ/m^2
Nanopore size: 0.3nm – 100nm

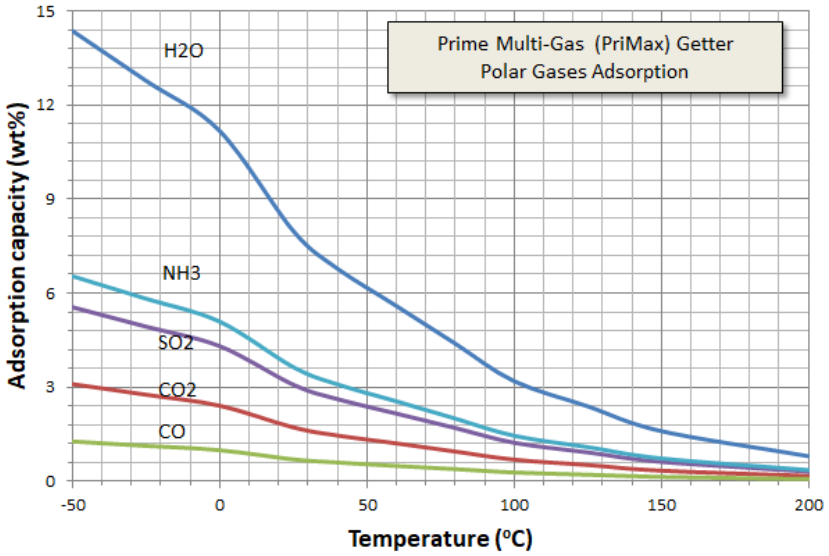
Hierarchically Porous Nanostructured Composite Getters

These composite materials embed microporous nanostructures into mesoporous nanostructures, which are further embedded into macroporous structures. This concept is similar to Russian nesting dolls, where smaller structures are nested within larger ones. Hierarchically nested porous nanostructured getter has highly promising for being used in any hermetic packaging systems, vacuum systems for scavenging prime gases.

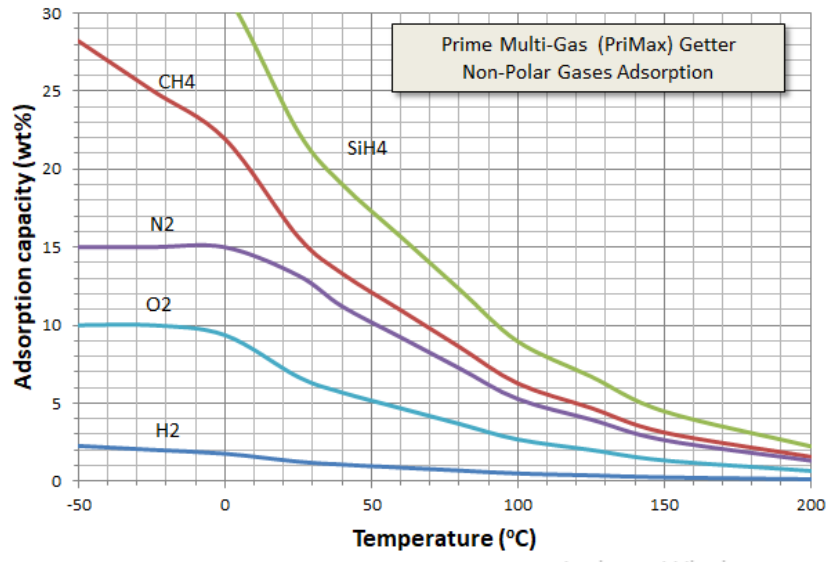
1. **Enhanced Surface Area**: The hierarchical structure combines micropores, mesopores, and macropores. This is multi-phase getter materials, which enable more efficient gas adsorption.
2. **Diverse Surface Energies**: The varying pore sizes in the hierarchical structure of NanoMax materials provide diverse surface energies, improving the adsorption capability for various gases. The synergy among micropores, mesopores, and macropores not only increases surface area but also enhances the range of surface energies enabling efficient adsorption of different gases and organic VOCs.
3. **Immediate Operation without High-Temperature Activation**: Hierarchically nested porous nanostructure composite getters can operate without activation, improving practicality and energy efficiency.
4. **Gas Absorption Mechanism**: PriMax Getter can adsorb gases not only on their surface but also within their internal nanoporous (0.3nm – 100nm). With a surface energy of 35–45 mJ/m², PriMax Getters efficiently adsorb both polar and non-polar gases, as well as organic VOCs.

6. **Vacuum Environment Applications**: Composed of inorganic materials, these getters exhibit extremely low outgassing properties. Gas absorption efficiency is optimal within medium to low vacuum pressure ranges (10^{-3} to 10^{-6} Torr) but decreases as vacuum levels increase. Due to strong van der Waals forces and electrostatic interactions with gas molecules, the structure of hierarchically porous nanostructured materials remains stable in a vacuum, allowing NanoMax materials to maintain high absorption capacity.

Prime Polar Gases



Prime Non-Polar Gases



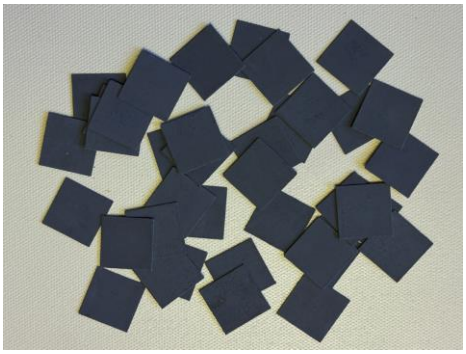
NANOFEA

NANOMAX
Getters Reimagined

PriMax Getters
(Vacuum Systems/Optic/MEMS/Hermetically Sealed Packages)

The dimensions and thickness of a getter are defined by its length, width, and thickness. As illustrated in the table below, standard getter sizes include 0.87” × 0.87” (22 mm × 22 mm), 0.70” × 0.70” (18 mm × 18 mm), 0.50” × 0.50” (12 mm × 12 mm), and 0.40” × 0.40” (10 mm × 10 mm). Customized dimensions are also available upon request. The adsorbing material typically comes in two thicknesses: 350 ± 10 µm for double-sided coatings on the substrate, and 300 ± 10 µm for single-sided coatings. For example, if the adsorption capacities for hydrogen, carbon dioxide, and moisture are known to be 1 wt%, 2wt%, and 10 wt%, respectively, a getter with dimensions of 0.87” × 0.87” can adsorb 0.75 mg H_2, 1.5 mg CO_2, and 7.5mg H_2O. To ensure a safety factor of 10, an electronic package may allow a maximum outgassing quantity of 0.075 mg H_2, 0.15 mg CO_2, and 0.75 mg H_2O over 20 years of operation. The actual adsorption quantity is determined by the capacity at a specific temperature, humidity, and partial pressure.

Standard Getter Sizes	Type of Getter Coating	Adsorption Material Weight (mg)	Adsorption Layer Thickness (µm)	Getter Weight (g)	Getter Thickness (µm)	1 wt% H_2 Adsorption (mg)	2 wt% CO_2 Adsorption (mg)	10 wt% Moisture Adsorption (mg)
0.87"x0.87"	Double sides	75	150	0.285±0.005	350±10	0.75	1.50	7.5
	Single-side	50	100	0.260±0.005	300±10	0.50	1.00	5.0
0.70"0.70"	Double sides	50	150	0.200±0.005	350±10	0.50	1.00	5.0
	Single-side	35	100	0.185±0.005	300±10	0.35	0.70	3.5
0.50"x0.50"	Double sides	25	150	0.096±0.005	350±10	0.25	0.50	2.5
	Single-side	15	100	0.086±0.005	300±10	0.15	0.30	1.5
0.40"x0.40"	Double sides	15	150	0.065±0.005	350±10	0.15	0.30	1.5
	Single-side	10	100	0.060±0.005	300±10	0.10	0.20	1.0



PriMax Getters

Pre-use preparation: To eliminate adsorbed moisture from the getter prior to package installation, heat the getter at 80–100°C for 24–72 hours under vacuum conditions (<10^{-5} Torr). After this treatment, perform a dry N_2 or Ar purge to prevent re-adsorption of moisture before assembly.

sales@nanofea.com +1 (720) 703-4266
www.nanofea.com