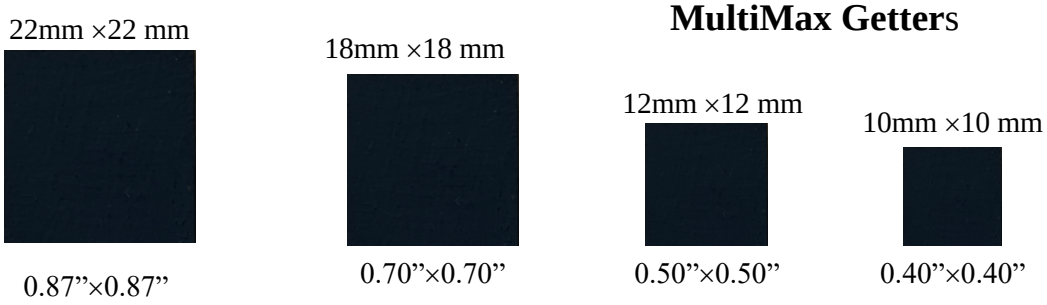
NANOFEA

NANOMAX
Getters Reimagined

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

MultiMax Getters



Thickness：300±50μm

NanoFEA (Nano Functional Engineering Atmospheres) has designed and developed a series of multifunctional nanomaterials for absorbing a variety of gases. These hierarchically porous nanostructured materials are specifically designed to absorb harmful polar gases (such as H_2O, CO_2, CO, NH_3, SO_2, etc.), non-polar gases (such as H_2, O_2, N_2, CH_4, and SiH_4), as well as polar and non-polar organic hydrocarbons and volatile organic compounds. They are intended for use in demanding and challenging vacuum equipment or hermetic packaging systems. NanoMax material based gas absorption getters offer a cost-effective solution, which has been patented as disclosed in US Patent Application# 2025/0073666 A1 and 2025/0091030 A1.

The MultiMax hierarchically porous nanostructured materials provide a novel method for gas absorption in vacuum equipment and hermetic packaging systems. These harmful gas substances can degrade vacuum levels, impair measurement accuracy in vacuum equipment or instruments, and affect the reliability of long-term measurement data.

Benefits of MultiMax Getters

- Capable of absorbing both polar gases (e.g., H_2O, CO_2, CO, NH_3, SO_2) and non-polar gases (e.g., H_2, O_2, N_2, SiH_4).
- Capable of absorbing polar hydrocarbons and volatile organic compounds (VOCs) (e.g., Acetone (C_3H_6O), Ethanol (C_2H_6O), Methanol (CH_4O), Formaldehyde (CH_2O), Acetaldehyde (C_2H_4O), Isopropanol (C_3H_8O), Methyl Ethyl Ketone (C_4H_8O), Ethyl Axetate ($C_4H_8O_2$), and Ethyl Axetate ($C_4H_8O_2$))
- Capable of adsorbing non-polar hydrocarbons and VOCs (e.g., Benzene (C_6H_6), Toluene (C_7H_8), Xylene (C_8H_{10}), Hexane (C_6H_{14}), Ethane (C_2H_6), Propane (C_3H_8), Styrene (C_8H_8), Ethylbenzene (C_8H_{10}), Methylene Chloride (CH_2Cl_2), and Trichloroethylene (C_2HCl_3)).
- 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.

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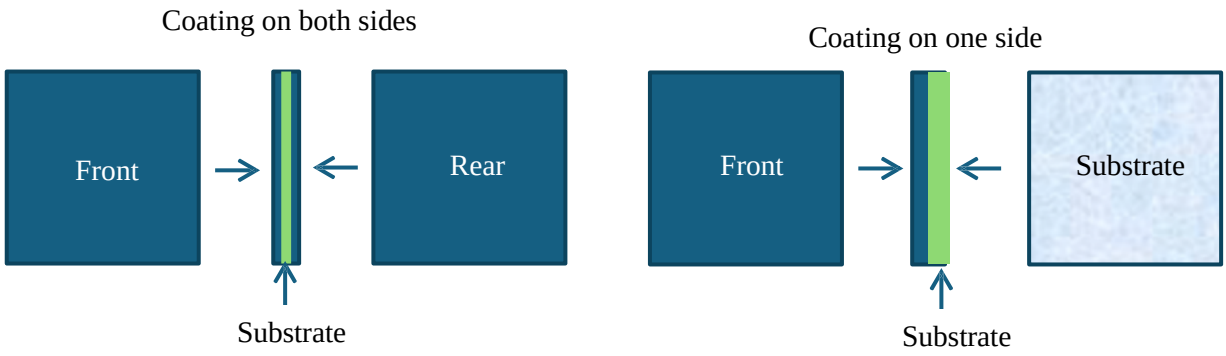


Substrate materials: Glass (borosilicate glass and silicate glass), ceramics (alumina, purity 92-99%), metals (titanium (Ti), copper (Cu), Kovar alloy, aluminum alloy).

Material Physical Properties:

Density: 1.20±0.20 g/cm^3

Dielectric constant: 2.4±0.1

Thermal conductivity: 0.25±0.05 W/m·K

Coefficient of thermal expansion (CTE): 7.5±2.5 ppm/^{o}C

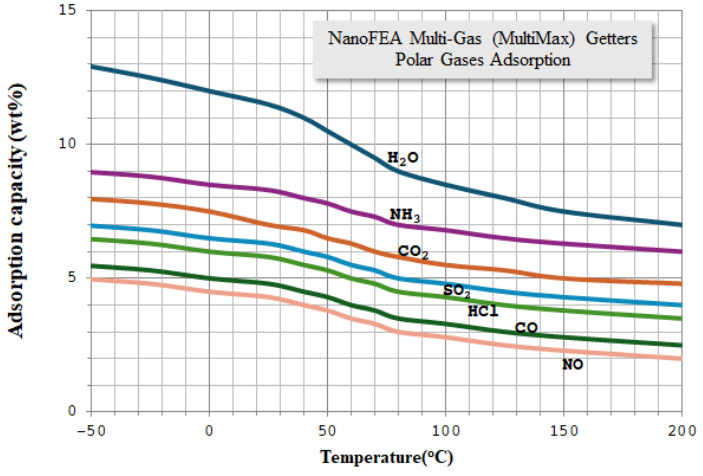
Young's modulus: 3.5±1.5 GPa

Electric Insulation resistance: 10^{12} – 10^{14} Ω·cm

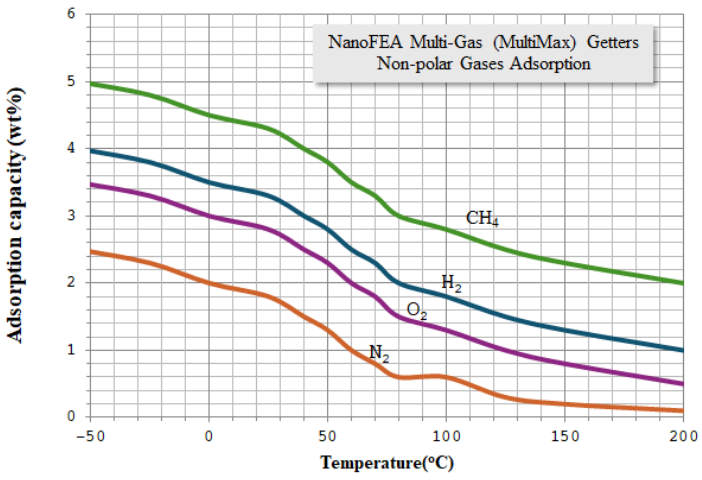
Surface energy: 30-45 mJ/m^2

The appearance of the material: Colors – gray to off-white, light black, and black

Prime Polar Gas Sorption



Prime Non-polar Gas



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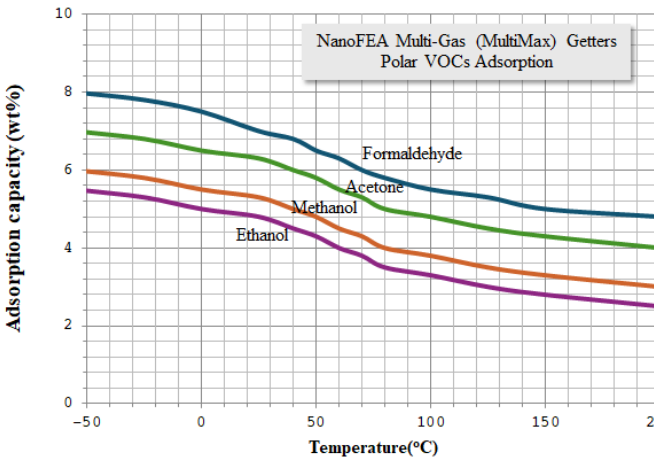
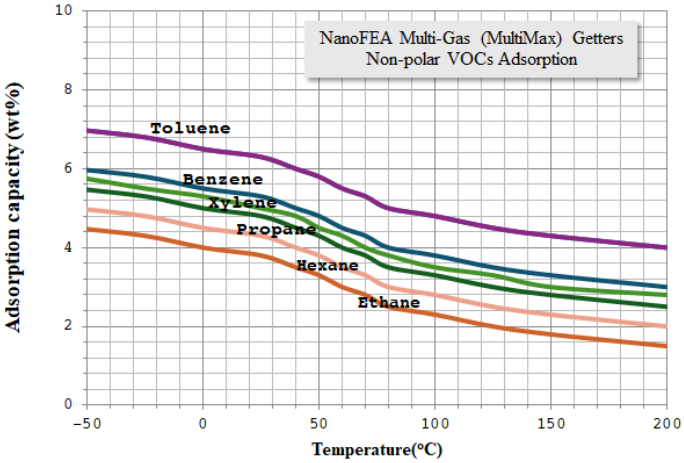
Prime Polar Organic VOCs



Prime Non-polar Organic VOCs



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 nanostructure composite getter materials have promising for being used in hermetic packaging systems, vacuum systems.

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**: MultiMax Getters can adsorb gases not only on their surface but also within their internal nanopores (ranging from 0.3 nm to 100 nm). With a surface energy of 30–45 mJ/m², MultiMax Getters efficiently adsorb both polar and non-polar gases, as well as organic hydrocarbons (HCs) and volatile organic compounds (VOCs).
5. **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 MultiMax materials to maintain high absorption capacity.

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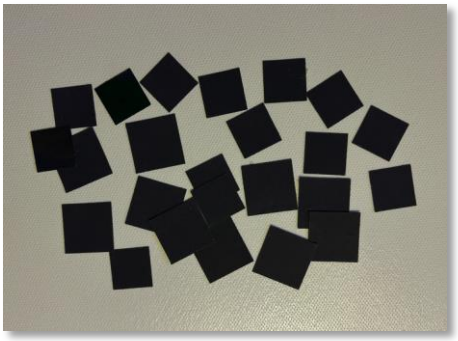
The dimensions and thickness of a getter are defined by its length, width, and thickness. As illustrated in the table below, standard getter sizes include 0.87” × 0.87” (22 mm × 22 mm), 0.70” × 0.70” (18 mm × 18 mm), 0.50” × 0.50” (12 mm × 12 mm), and 0.40” × 0.40” (10 mm × 10 mm). Customized dimensions 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 moisture, hydrogen, and VOCs are known to be 1 wt%, 10 wt%, and 15 wt%, respectively, a getter with dimensions of 0.87” × 0.87” can adsorb 7.5 mg moisture, 0.75 mg hydrogen, and 11.3 mg VOCs. To ensure a safety factor of 10, an electronic package may allow a maximum outgassing quantity of 0.75 mg moisture, 0.075 mg hydrogen, and 1.13 mg VOCs 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 (mm)	1 wt% Hydrogen Adsorption (mg)	10 wt% Moisture Adsorption (mg)	15 wt% VOCs Adsorption (mg)
0.87"x0.87"	Double sides	75	150	0.285±0.005	350±10	0.75	7.5	11.3
	Single-side	50	100	0.260±0.005	300±10	0.50	5.0	7.5
0.70"0.70"	Double sides	50	150	0.200±0.005	350±10	0.50	5.0	7.5
	Single-side	35	100	0.185±0.005	300±10	0.35	3.5	5.3
0.50"x0.50"	Double sides	25	150	0.096±0.005	350±10	0.25	2.5	3.8
	Single-side	15	100	0.086±0.005	300±10	0.15	1.5	2.3
0.40"x0.40"	Double sides	15	150	0.065±0.005	350±10	0.15	1.5	2.3
	Single-side	10	100	0.060±0.005	300±10	0.10	1.0	1.5

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.



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