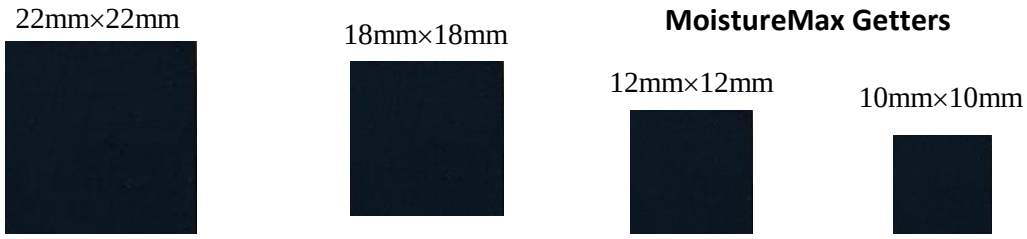
NANOFEA

NANOMAX
Getters Reimagined

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



Adsorption capacity: 30-40 wt%

NanoFEA (Nano Functionally Engineered Atmospheres) manufactures a comprehensive range of industry-leading getter materials, engineered to capture harmful polar gases (e.g. H_2O, CO_2, CO, SO_2, etc.), non-polar gases (e.g., H_2, O_2, N_2, CH_4 and SiH_4), polar HCs/VOCs and non-polar HCs/VOCs in harsh and challenging environments. Our MoistureMax materials offer a fresh approach to scavenging unwanted moisture/water vapor that compromise the quality and long-term reliability of electronic, microelectronic, and photoelectronic packages and devices. MoistureMax Getter is one of cost-effective solutions by its high adsorption capacity of 30-40wt% for adsorbing moisture and water vapor from any electronic devices, modules, and packages. 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.

Our "Best in Class" MoistureMax Getters represent the advanced getter materials, thoughtfully designed by NanoFEA with a deep understanding of the challenges faced in diverse industries. We prioritize our customers' needs for quality, long-term reliability, and product success, ensuring our innovative products meet the highest standards.

MoistureMax Getter – Benefits

- **High Moisture Adsorption**: The adsorption capacity for moisture can be from 10wt% to 20wt% under 30-60%RH.
- **Water Vapor Adsorption**: The adsorption capacity for water vapor can be from 25-30wt% under 60-80%RH.
- **Condensed Free Water Adsorption**: The adsorption capacity for free or condensed water can be from 30-40wt% under 80-100%RH
- **Versatile Sizes**: Available in standard and customized sizes to fit any enclosures (see page 2).
- **Lightweight & Low Profile**: Ensures superior performance without adding bulk.
- **Easy Application**: Can be applied to any surface using our high-temperature adhesive films or the epoxy of your choice.
- **Wide Temperature Range**: Functions efficiently from -55°C to +300°C.
- **No Activation Required**: Ready to use without the need for activation or regeneration.
- **Long Shelf Life**: Retains effectiveness for up to 2 years from the date of purchase.

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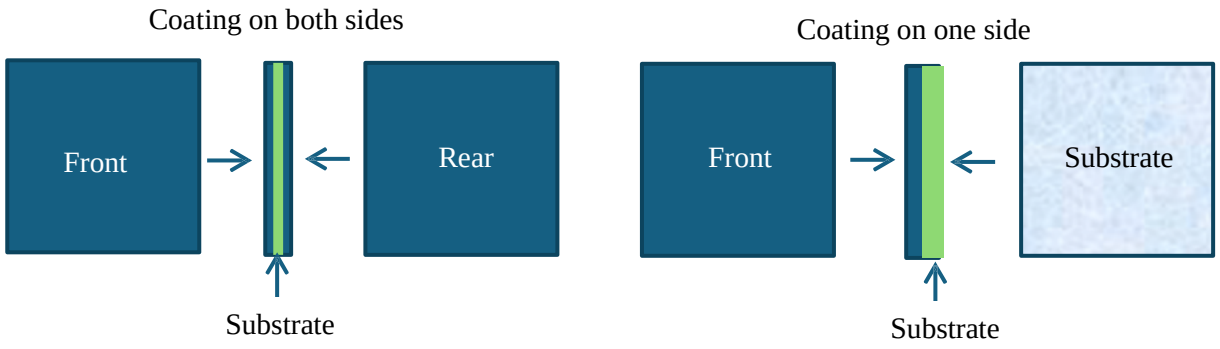
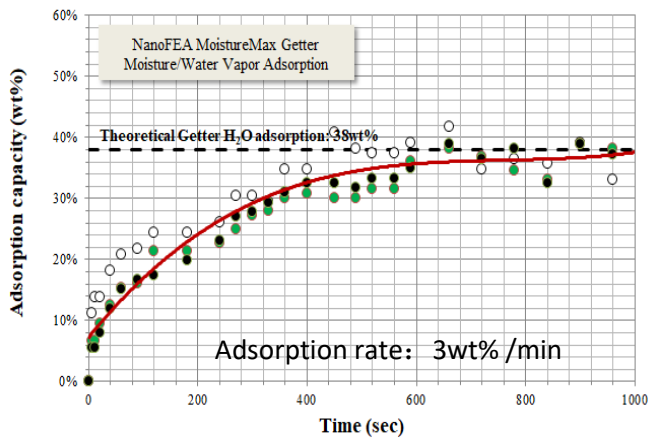


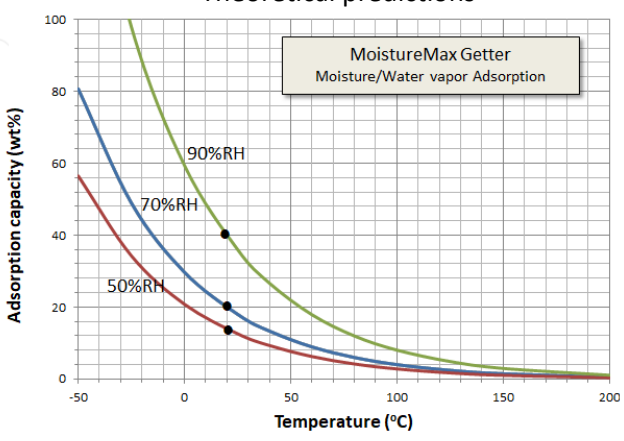
These composite materials embed microporous nanostructures into mesoporous nanostructures, which are further embedded into macroporous structures. This concept is similar to Russian nesting dolls, where smaller structures are nested within larger ones. The hierarchically nested porous nanostructures have potential applications in vacuum systems or any instruments requiring a vacuum environment, due to their multiphase, multi-microporosity, and broad surface energy distribution advantages.

1. **Enhanced Surface Area**: The hierarchical structure combines micropores (<1 nm), mesopores (<50 nm), and macropores (<100 nm). Compared to traditional single-phase or single-surface energy getter materials, the surface area is significantly increased. While conventional getters rely on their surface to adsorb or absorb gas molecules, the hierarchically nested nanoporous network can more efficiently adsorb gas molecules.
2. **Diversified Surface Energy**: The varied pore sizes within the hierarchical structure provide diverse surface energies, enhancing the ability to adsorb a wide range of gases. This makes composite getters more adaptable and effective in various vacuum environments.
3. **High Adsorption Capacity**: The synergy among micropores, mesopores, and macropores not only provides a larger surface area but also introduces diverse surface energies, enabling the getter to efficiently adsorb different outgassed molecules.
4. **Activation Temperature**: Traditional non-evaporable getters typically require high temperatures (300–600°C) for activation and regeneration, which may pose challenges in practical applications. In contrast, the hierarchically nested porous nanostructure composite getter can be used without activation, improving its practicality.

Measured Adsorption



Theoretical predictions



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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 capacity for moisture is known to be 20 wt%, a getter with dimensions of 0.87” × 0.87” can adsorb 15 mg moisture. To ensure a safety factor of 10, an electronic package may allow a maximum outgassing quantity of 1.5 mg moisture outgassing 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)	20 wt% Moisture Adsorption (mg)
0.87"x0.87"	Double sides	75	150	0.285±0.005	350±10	15.0
	Single-side	50	100	0.260±0.005	300±10	10.0
0.70"0.70"	Double sides	50	150	0.200±0.005	350±10	10.0
	Single-side	35	100	0.185±0.005	300±10	7.0
0.50"x0.50"	Double sides	25	150	0.096±0.005	350±10	5.0
	Single-side	15	100	0.086±0.005	300±10	3.0
0.40"x0.40"	Double sides	15	150	0.065±0.005	350±10	3.0
	Single-side	10	100	0.060±0.005	300±10	2.0

Material Physical Properties:

Density: 1.00±0.05 g/cm^3
Dielectric constant: 2.75±0.25
Thermal Conductivity: 0.15±0.05 W/m·K
Surface Energy: 48-55 mJ/m^2
Coefficient of thermal expansion (CTE): 20±2 ppm/^{o}C
Young’s Modulus: 12.0±1.0 GPa
Electrical Insulation Resistance: 10^{12} –10^{14} Ω·cm
Material Structures: Hierarchical porous nanostructures
Appearance (e.g., color): Gray, light black, or black
Substrate: Metal (Ti, Cu, Ni, Kovar, Al-alloy), Ceramic (Alumina 92-99% purity), Borosilicate and silicate glasses

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.