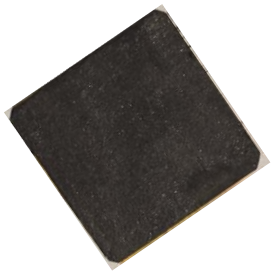
NANOFEA

NANOMAX
Getters Reimagined

HyMAX and HyMAX-HT
High-Capacity Hydrogen Getters

HyMAX materials are designed with two operating temperatures in mind: HyMAX being suitable for moderate temperature applications and HyMAX-HT suited to more extreme temperatures.



HyMAX and HyMAX-HT		
Product	**Operating Temperature**	**Adsorption**
HyMAX	-55°C to 125°C	5-10 wt% H2
HyMAX-HT	-162°C to 300°C	10-20 wt% H2

NanoFEA (Nano Functionally Engineered Atmospheres) has leveraged its hierarchically porous nanostructured materials, disclosed by U.S. Patent Application Nos. 2025/0073666 A1, 2025/0091030 A1, 2025/0108356 A1, and 18/800,083 (2024), as next-generation high-capacity H_2 getters for scavenging outgassed hydrogen gas from packaging materials (polymers, epoxies, PCBs and Ni/Au plating etc.). Designed and manufactured by NanoFEA, these advanced hydrogen getters provide a robust defense against outgassed hydrogen, effectively preserving device performance and ensuring reliable operation over lifespans of up to 20 years.

Typical Applications:

- MEMS-based inertial sensors and gyros
- Photodiode and image sensor packages
- Implantable pacemakers and stimulators
- Optoelectronic modules (VCSELs, laser diodes)
- Space/aerospace avionics packages

H_2 getters are essential in maintaining the long-term stability and performance of sealed microelectronic, photoelectronic, and medical device packages. The following outlines HyMAX critical advantages:

1. Prevents Hydrogen Induced Failure	Aborbs Outgassed Hydrogen that can cause metal corrosion, delamination, dielectric breakdown and functional drift
2. Maintains Package Integrity	Prevents internal pressure build-up from hydrogen accumulation, minimizing risk of lid bulging or cracking
3. Stabilizes Optical Components	Protects sensitive coatings, laser diodes and photodetectors from hydrogen related performance degradation
4. Enhances Vacuum and Inert Gas Environments	Maintains low pressure or controlled gas compositions in IR sensors, MEMS and image sensors.
5. Ensures Longevity and Reliability	Enables 10 to 20 year+ service lif in mission critical and implantable systems by removing reactive hydrogen.
6. Compatible with Miniaturization	Especially effective in compact packages with limited internal volume where trace hydrogen has amplified effects.
7. Mitigates Material Outgassing Effects	Adsorbs hydrogen released from adhesives, polymers, and internal corrosion without requiring complex degassing procedures
8. Biocompatability Support	Protects implanted medical devices from hydrogen induced anomalies that may impact sensors or electronic function.

NanoFEA, LLC 4245 N Central Pkwy, #492, Dallas, TX 75205 email: Sales@nanofea.com Ph: +1(720)703-4622

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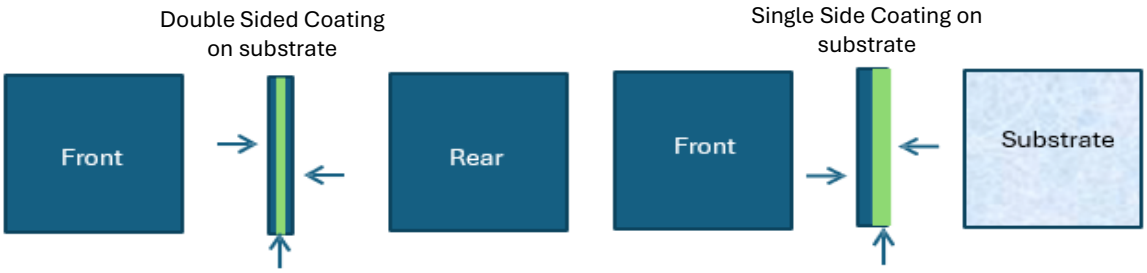

Getter Color: Gray to off-white, light black, and black

Available in Stock Sizes					
Size in mm (Square)	5,0	10,0	12,7	17,8	22,8
Size in Inches (Square)	.200”	.400”	.500”	.700”	.900”
Custom sizes also available					

NanoMAX Materials Physical Properties

- Material Surface Energy: 30-50 mJ/m^2
- Thermal conductivity: 0.04-0.08 W/m·K
- Electrical Volume Resistivity: 10^8–10^{14} Ω·cm
- RF Adsorption (<1GHz): weak attenuation <10dB/cm
- Microwave absorption (2–18 GHz): 5–10 dB Reflection loss for 2mm film
- Density: 1.0±0.1 g/cm^3
- Coefficient of Thermal Expansion: 8-20 ppm/^{o}C
- Young’s Modulus: 0.1±1.0 GPa
- Relative dielectric constant (1kHz): 1.2-1.5

Industrial Applications of High-Capacity Hydrogen Getters

APPLICATIONS	Predicted Hydrogen Outgassing	Required H2 absorption
Microelectronic Packages	10-100 cc packages may have 3 to 5% Hydrogen outgassing.	0.1 to 0.5 mg for 20 years
Optical/ Photonic/ Photoelectronics	10-100 cc packages may have 5 to 10% Hydrogen outgassing.	0.25 to 1.0 mg for 20 years
Medical Devices and packages	Implantable pacemakers and stimulators	~30 mg per year
Vacuum Systems	IR Detectors, MEMS Gyroscopes	~30 mg per year
Supercomputer Cooling Systems	Electrolysis and Corrosion	~500 mg per year
Cryogenics/ LNG	LNG may contain ~100ppmv Hydrogen	~2000 mg H2
Fuel Cells	2.5kg Hydrogen gas tank with 0.1% H2 leakage rate	2500 mg
Energy Storage Systems	Electrochemical reactions in batteries with 0.1mg per charging cycle.	2,000 to 5,000 mg per year
Nuclear Reactor Vessels	Radiolysis of water	1,000 to 5,000 mg per year

Hydrogen (H_2) is frequently outgassed from sources such as polymers, adhesives, metal corrosion, and residual moisture. In miniaturized devices, even trace amounts can have significant impact. By actively scavenging this byproduct, hydrogen getters help maintain critical internal environmental conditions—reducing the reliance on ultra-clean materials or complex degassing procedures. Integrated hydrogen getters enable miniaturized designs without compromising reliability.

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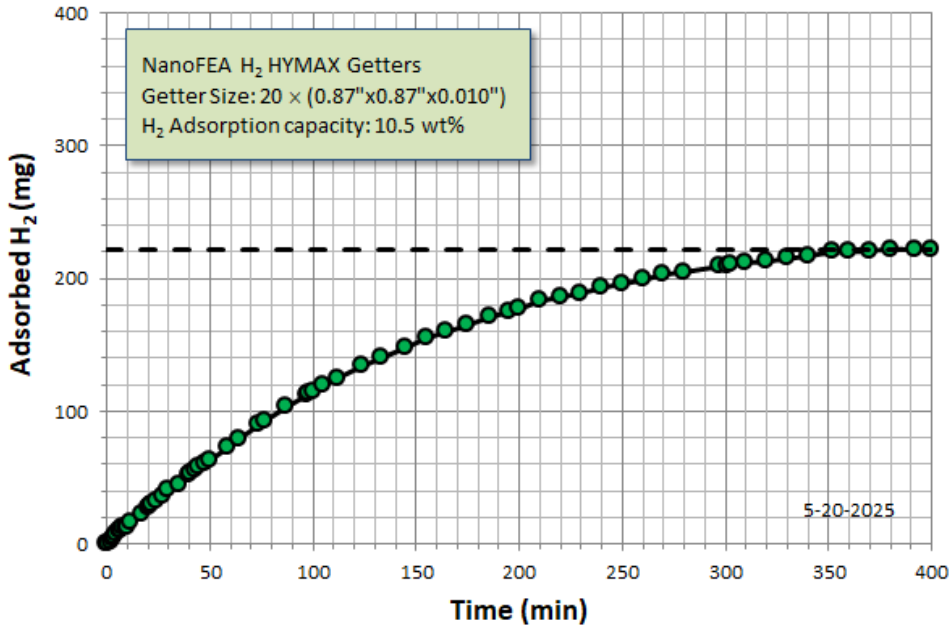
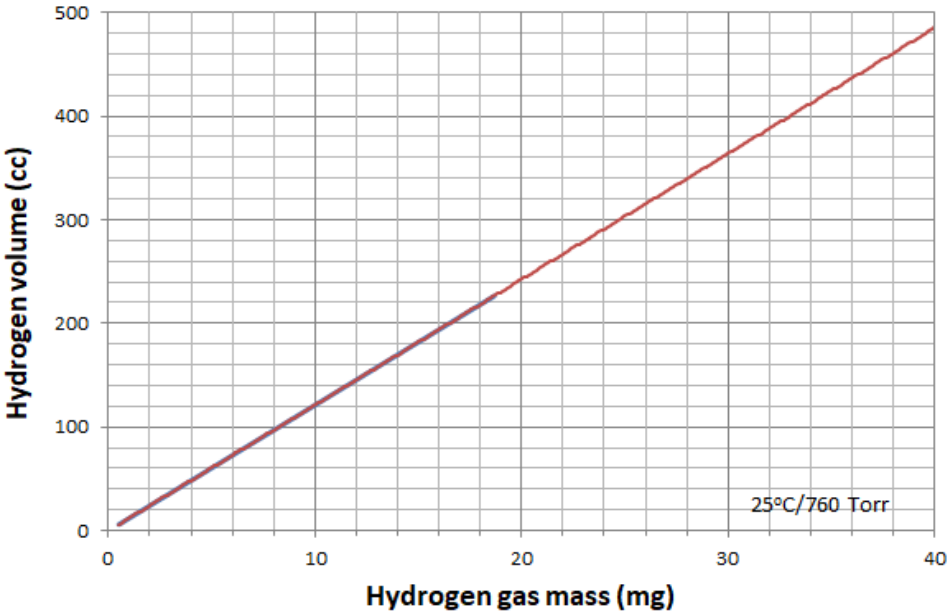
Getter sizes and performance: The dimensions of a getter are defined by its length, width, and thickness. The H_2 absorption capacity of a NanoMAX HyMAX getter in a 22,8mm (.870") square format is shown below:



The hydrogen gas with mg unit can be expressed by the gas volume as below:



Most microelectronic, medical, and photoelectronic packages have a volume less than 100 cm^3 (cc), even less than 10 cc. Outgassed hydrogen gas in these cases is much less than 1mg with a few cm^3 volumes. The high-capacity H_2 getter is well suited as a premier passive safety element for use in wide industrial systems, such as fuel cells, batteries, energy storage, supercomputers, vacuum system, and nuclear reactors.

When Reliability and Product quality are paramount, look no further than NanoMAX – We're Getters Reimagined

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