NANOFEA

NanoMAX

User Guide

NANOMAX

Getters Reimagined

NANOMAX GETTERS

- NanoF-E-A Functional/ Engineered/ Atmospheres
- Provide comprehensive solutions to protect microelectronics under the most demanding conditions.
- Driven by a customer-centric philosophy
- Develop solutions engineered to offer improved reliability
- Utilize nanomaterials, expert engineering practices, and specialized manufacturing techniques to deliver engineering solutions that are accurate, reliable, and timely
- Getting it right the first time, every time.
- Technically sound, information rich.

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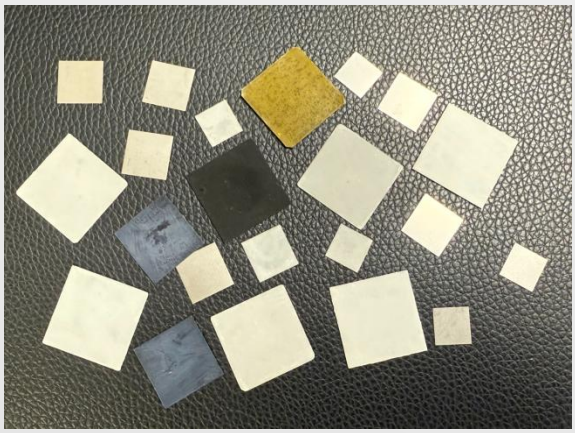
ABOUT US

NanoFEA is breaking new ground in getter performance with the launch of NanoMAX; nanomaterials based getters. This next generation of innovative gas, moisture, organic, and particle scavenging systems combines ease of use with exceptional performance. Engineered to operate at peak levels even in harsh environments, NanoMAX effectively eliminates these harmful contaminants. It ensures the greatest long-term product reliability and device performance across a myriad of technologies, products, and markets.

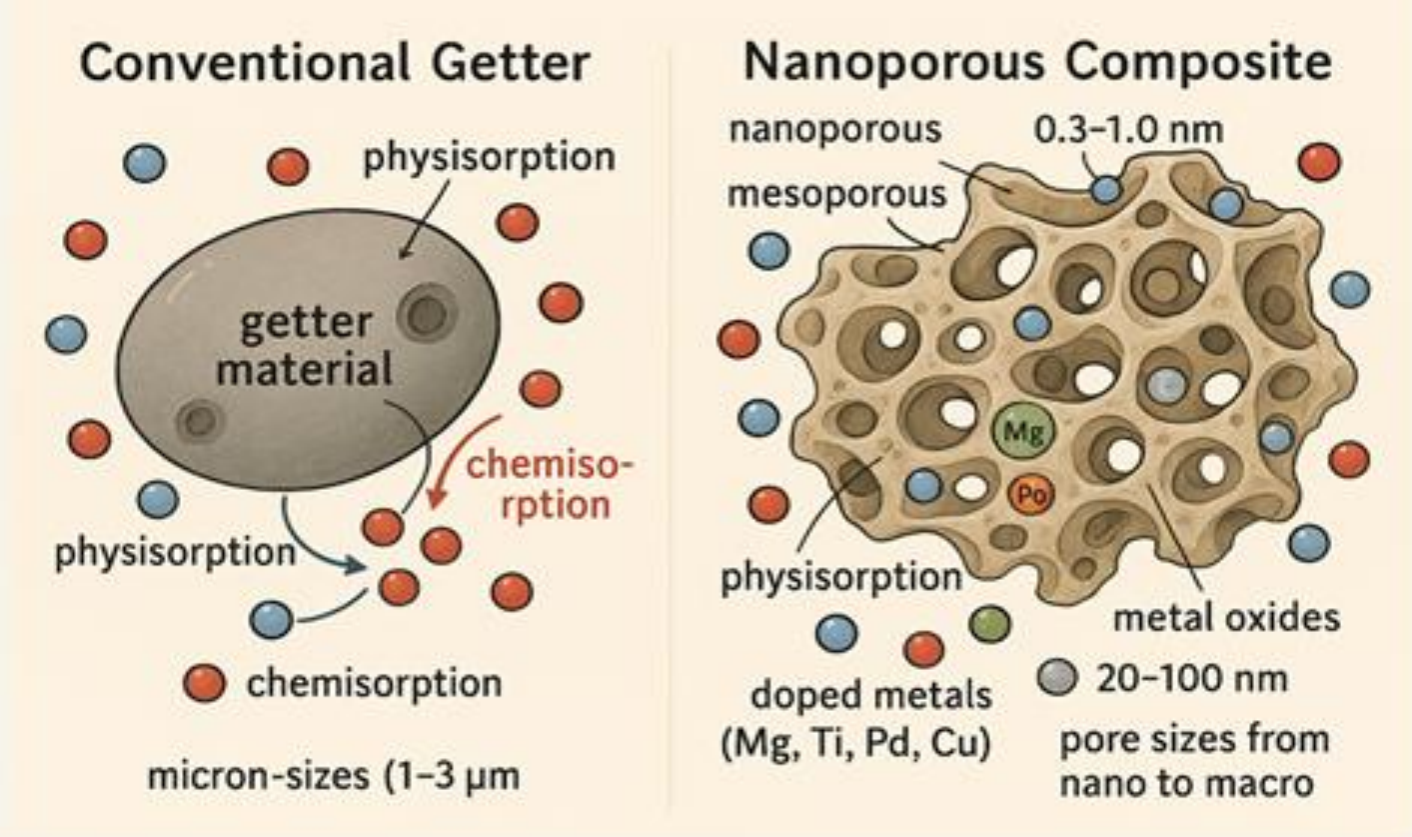
At NanoFEA, we've taken a fresh new look at eliminating harmful contaminants with an eye to assuring the user the greatest long term product reliability and device performance for a myriad of technologies, products and markets.



ABOUT NANOMAX

Legacy Getters use Chemisorption (Chemical Adsorption)

NanoMAX Getters use Physisorption (Physical Adsorption)



Why it Matters

Chemisorption

- **Dependent on the use of precious metals to bind small molecule gases.**
- **Always require Activation**
- **Long Sales Cycle**
- **Larger form factors required**
- **Need to buy a lid and a getter together, or send your lid somewhere to have a getter added**

Physisorption

- **Uses Physisorption to capture all gases and particles.**
- **Does NOT require activation**
- **Short Sales Cycle**
- **Smaller form factors needed.**
- **Very high safety factor**
- **Out perform Lagacy getter materials by 2 to 4x in same form factor**
- **Pick and place**

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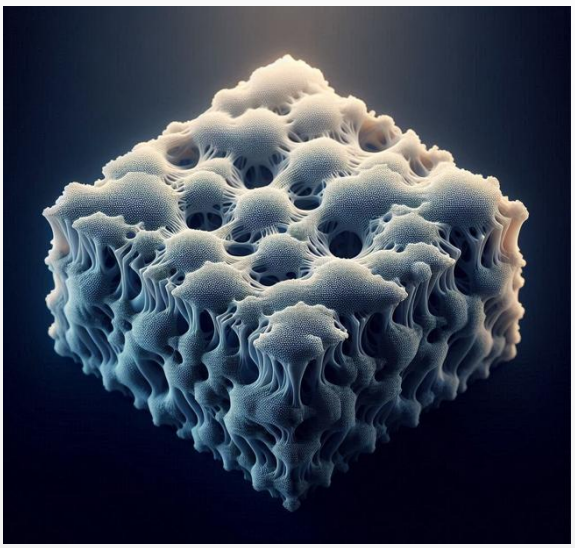
WHAT IS NANOMAX?

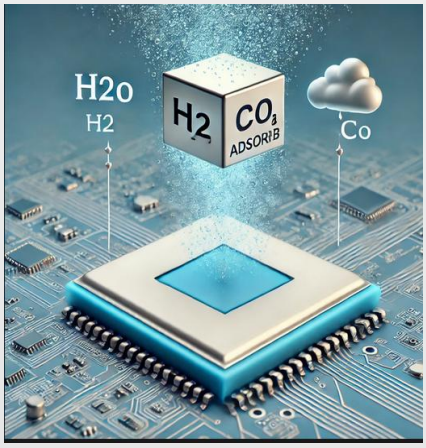
HIERARCHICAL POROUS NANOSTRUCTURED COMPOSITE



NanoFEA Filed US Patents
US18/800,083, US18/953,025
US18/964,584, US18/977,893

- Polar gases (H_2O, CO_2, CO, SO_2, NH_3 …)
- Non-polar gases (H_2, O_2, N_2, CH_4, SiH_4)
- Polar VOCs (5wt%)
- Non-Polar VOCs (13wt%)
- Particulate Matter

Multi-Gas, VOCs, Particles, Prime, Moisture and All-in-One Getters



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GETTER PRODUCTS

MultiMax

- Polar gases
- Non-polar gases
- Hydrocarbons
- Small polar VOCs
- Small non-polar VOCs

AllMax

- Polar gases
- Non-polar gases
- Hydrocarbons
- Small polar VOCs
- Small non-polar VOCs
- Electric particles
- Magnetic particles
- Dielectric particles
- Fine dust particles
- Microbial contaminants

PriMax

High Priority polar gases

- H_2O, CO_2, CO
- Non-Polar gases
- H_2, O_2, N_2, SiH_4

MoistureMax

- Moisture

VOCMax

- Hydrocarbons
- Small to large polar VOCs
- Small to large non-polar VOCs
- Moisture (H_2O)

ParticleMax

Particulate Matter

- Electric Particles
- Magnetic Particles
- Dielectric particles
- Fine dust particles
- Microbial contaminants

HyMax and HyMAX-HT

- Hydrogen

CryoMax

- Hydrogen in cryogenic applications

SilMAX

- Moisture and hydrogen in legacy format

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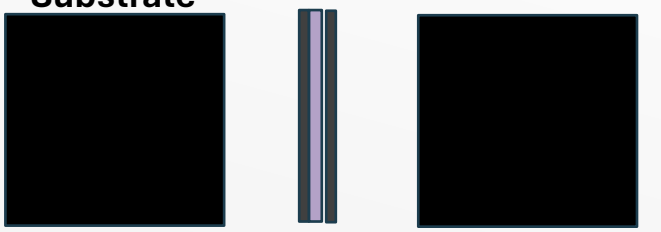
NANOMAX CAPTURE CLASSIFICATIONS

NANOMAX GETTERS		ParticleMax	MultiMax	VOCMax	MoistureMAX	HyMAX and HyMAX-HT	ALLMax	PriMax	SilMAX	CryoMAX
Polar Gases	Moisture/Water vapor (H_2O)	✓	✓	✓	✓		✓	✓	✓	
	Carbon Dioxide (CO_2)		✓				✓	✓		
	Carbon Monoxide (CO)		✓				✓	✓		
	Ammonia (NH_3)		✓				✓			
	Sulfur Dioxide (SO_2)		✓				✓			
	Hydrogen Chloride (HCl)		✓				✓			
	Nitride Oxides (NO)		✓				✓			
	Nitrogen Oxides (NO_2)		✓				✓			
	Hydrogen Fluoride (HF)		✓				✓			
Non-Polar Gases	Hydrogen (H_2)		✓			✓	✓	✓	✓	✓
	Oxygen (O_2)		✓				✓	✓		
	Nitrogen (N_2)		✓				✓	✓		
	Methane (CH_4)		✓				✓			
Polar VOC's	Acetone (C_3H_6O)		✓	✓						
	Ethanol (C_2H_5OH)		✓	✓						
	Methanol (CH_3OH)		✓	✓						
	Formaldehyde (CH_2O)		✓	✓						
Non-Polar VOC's	Benzene (C_6H_6),		✓	✓						
	Toluene (C_7H_8),		✓	✓						
	Xylene (C_8H_{10})		✓	✓						
	Hexane (C_6H_{14})		✓	✓						
	Ethane (C_2H_6)		✓	✓						
	Propane (C_3H_8)		✓	✓						
Particulate Matter	Electric Particles	✓					✓			
	Magnetic Particles	✓					✓			
	Dielectric Particles	✓					✓			
	Fine Dusts	✓					✓			
	Microbial Contaminants	✓					✓			
			Small HCs/VOCs	Small to Large HCs/VOCs						

How we build NanoMAX

Double Sided

Substrate

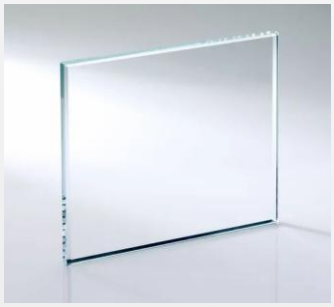


NanoMAX

Single Sided

Substrate

Common Substrate Materials



Glass

Borosilicate Glass
- .004” thick
- Lightweight

Ceramics

Typically Alumina Al_2O_3
- .004”/ .010” thick
- Lightweight

Metals

Copper, Aluminum
- .004” thick
- Lightweight

NanoMAX Application Process
- Screen Printing
- 3D Printing
- Spray
- Stencil
- Dispense

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How to Use NanoMAX

Mounting Techniques

Method	Suitable for	Notes
Adhesive bonding	Glass/ceramic, metal foil	Use low-outgassing epoxies or silicone; cure under vacuum or inert gas
Laser Welding	Metal Foil	Precise, localized bonding; ideal for high-reliability packages
Spot Welding	Metal Foil	Fast and scalable; ensure thermal budget doesn't degrade getter
Hi Temperature Tapes	Glass/ceramic, metal foil	Double sided tapes
Mechanical Clamping	All types	Temporary or reversible; used in test modules or reworkable designs

Recommended Epoxies

Brand	P/N	Cure Temperature	Suggested Operating Temp	Certifications	NASA Certified?
Dow Corning	RTV3145	Room Temp	< 200°C	MIL-A-46146	No
Epotek	377	150° C	-196 – 250C	ASTM E595	Yes
Epotek	H20E		-55 to 150C	Low outgassing – good for metal bonding	No
Supreme	12AOHT-LO	150° C	< 260°C	ASTM E595	Yes
Sylgard	577		< 200°C	ASTM E595 85/85	Yes

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How to Attach NanoMAX

Recommended Tape

Brand	P/N	Single or Double Sided	Service Range	Thickness
NanoMAX Tape	NT343	Double Sided	-63° C to +260° C	.005”/ 127µm

* https://www.nanofea.com/index.php/products/

Tack or Spot Welding

Material Dependent

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How to Attach NanoMAX

Installation Strategies for Coated Getters

Single-Side Coated Getters

Installation: The uncoated side is bonded to the package using adhesive or double sided tapes, leaving the active side fully exposed.
Advantages: Maximizes adsorption surface area; no loss of capacity due to adhesive coverage.
Use Case: Ideal for planar mounting on lids, walls, or standoffs in hermetic enclosures.

Double-Side Coated Getters

Bonding one side with adhesive will occlude that surface, reducing effective adsorption area. Typically 40–50% adsorption reduction if one side is fully covered, depending on film thickness and porosity.
Consider Edge Bonding with Minimal Adhesive – Apply adhesive only to the perimeter or corners.
Advantages:
Preserves most of the active area
Provides mechanical stability
Caution: Validate adhesive spread and cure profile to avoid bleed-over.

Use spring clips, mesh frames, or wedge clamps to secure the getter without adhesive contact.

Advantages:
Zero occlusion of active surfaces
Easy removal or replacement
Compatible with thermal cycling and MIL-STD-883 shock profiles
Design Tip: Use low-profile clamps with distributed pressure to avoid stress points or warping.

Spacer or Standoff Mounting

Method: Suspend the getter between posts or brackets, allowing airflow to both sides.
Advantages:
Full exposure to ambient gases
Minimal mechanical interference
Use Case: Ideal for TO-can, ceramics, or metal lid packages with vertical clearance.

Mesh Retention or Cage Housing

Method: Enclose the getter in a fine metal mesh or perforated cage.
Advantages:
Protects fragile coatings
Allows gas permeation from all directions
Materials: Stainless steel or Ni-coated mesh for corrosion resistance.

FOR MORE SPECIFIC INFORMATION ON ASSEMBLING NANOMAX GETTERS, ASK US FOR OUR TECHNICAL NOTE TITLED *"Installing NanoMAX getters in Electronic and Microelectronic Packages*.

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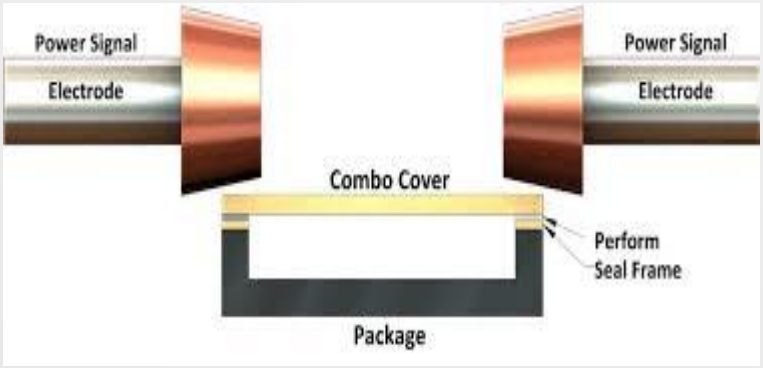
Assembly Recommendations

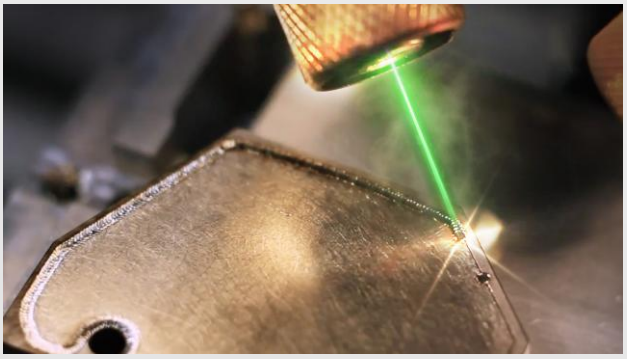
NanoMAX Materials do not <u>need</u> to be Pre-Baked prior to use!
But
Are able to handle pre-bake in your process

If you plan to Pre-Bake, we recommend:
Pre-use preparation: heat the getter at 100-150°C for 2 – 4 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.

NAnoMAX Materials will handle any down stream assembly process from:

Seam Sealing/ Welding
Laser Welding
Solder Reflow





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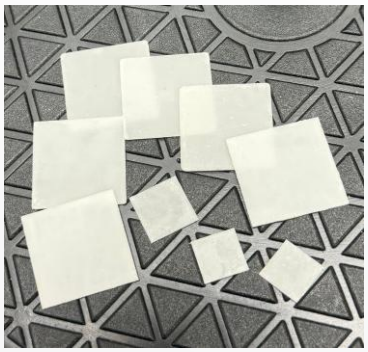
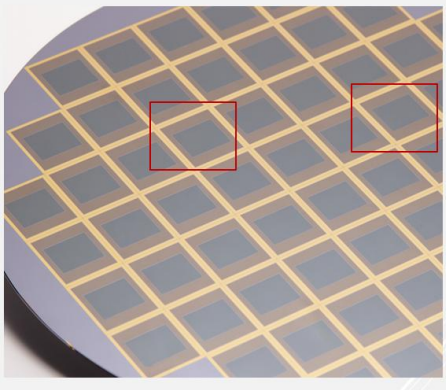
NanoMAX Gallery

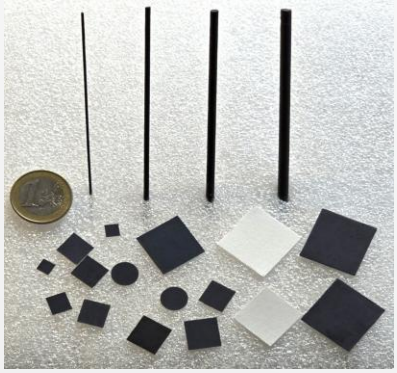
Mix of Product types



Particle



On Silicon



Multiple Shapes

MultiMAX in Hermetic lids

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SPECIALIZED SERVICES

Getter Design/ Fabrication

- Offer customized getter designs for diverse package outgassing and scavenging applications
- Offer in-house getter fabrications and tests

Outgas Analysis

- Identifying primary outgassing sources and amounts
- Providing outgassing analysis from package materials

Product Testing Services

- Package testing services
  - Outgassing, contamination, Failure analysis, etc.

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SUMMARY

NanoFEA's mission:

To combine NanoScience and thoughtful innovations to develop products and services of superior quality that safeguard and enhance our customers products quality and reliability

Our Vision:

Use our passion for science and ingenuity to power next-gen technologies

NanoFEA is a full service company offering getter technology and design consulting services that enhance performance and reliability of electronic products and technologies.

NanoMAX products stand at the junction of nanoscience and innovation and combine to benefit the mission in any sphere of operation

When product reliability, timeliness, service are paramount, look no further than NanoFEA.

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Contact US

For more information, please contact:

David DeWire
President at NanoFEA, LLC
4245 N. Central Expy, #490
Dallas, TX 75205
(720) 703-4266

ddewire@nanofea.com

Dr. Hua Xia
CEO at NanoFEA, LLC
4245 N. Central Expy, #490
Dallas, TX 75205
(720) 703-4266

hxia@nanofea.com

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