NanoMax Materials

NanoFEA, LLC

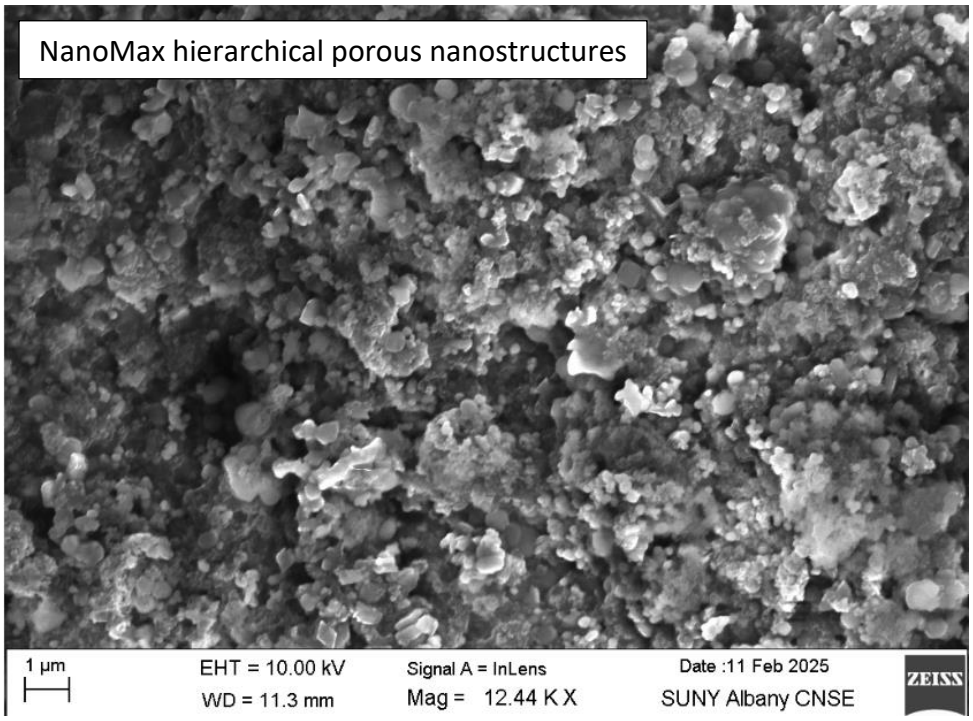
4245 N Central Expy, #492, Dallas, TX 75205, USA
www.nanofea.com, sales@nanofea.com, +1(720) 703-4266

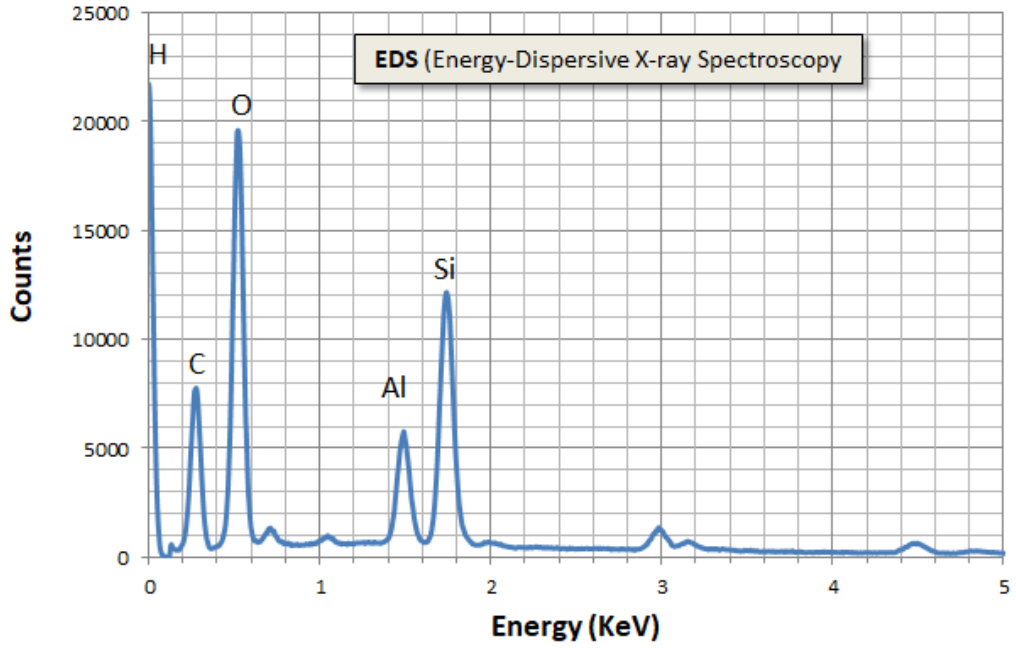
NanoMax Material Description:

NanoMax materials are absorbents or adsorbents that are specialized materials designed to adsorb moisture, polar gases (e.g., H_2O, CO_2, CO, NH_3, SO_2, NO, NO_2 etc.), and non-polar gases (H_2, O_2, N_2, CH_4, and SiH_4), polar VOCs and non-polar VOCs, PFAS, and Siloxanes from various environments, including clean room or chamber, Fuel cells, Batteries, Electronic Packages, Vacuum Systems, and vacuum required Analytical Instruments, Lamps, LEDs, Laser Diodes, thereby preventing potential performance degradation and ensuring high reliability throughout the lifespan of the protected devices.

Potential Industrial Applications:

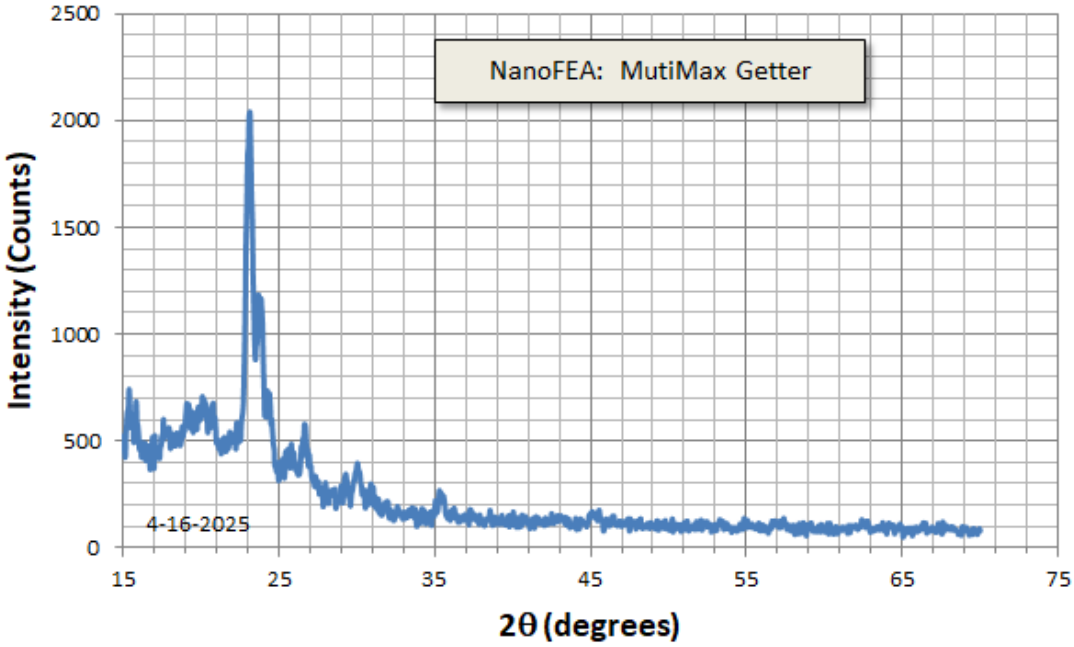
- This composite's ability to adsorb moisture, VOCs, Siloxane, and PFAS and gas pollutants makes it useful in various industries:
- Microelectronics & Hermetic Packaging
- Protects sensitive components from moisture and VOC/Siloxane outgassing in MEMS, semiconductors, and optical devices.
- Reduces contamination-related failures in hermetically sealed enclosures.
- Air and Gas Purification
- Used in HVAC systems to remove airborne pollutants, particulates, and humidity.
- Effective for air purification in industrial cleanrooms, hospitals, and laboratories.
- Energy Storage & Fuel Cells
- Can be used in lithium-ion battery enclosures to adsorb outgassed hydrocarbons and moisture.
- Helps improve hydrogen storage safety by controlling hydrogen release in fuel cells.
- Environmental Remediation
- Captures diverse emissions from paint, coatings, and chemical processing plants.
- Serves as an adsorbent for gas masks and protective filtration systems against toxic industrial chemicals.
- Oil & Gas Industry: Used in downhole electronics and subsea modules to protect against moisture and gas contamination.
- Applied in petrochemical plants for VOC control in refining processes.





NanoMax Material Composition: Si (30%), O (40%), Al (12%), C (17%), and other impurities less than 1%.

Material Structures: Hierarchical porous nanostructures with pore sizes from 0.5nm to 100nm, X-ray Diffraction data verified the nano-crystalline structures with particle sizes of 5-10nm.



Appearance (e.g., color): Gray to off-white, Light Black, and Black

Substrate: Metal (Ti, Cu, Ni, Kovar, Al-alloy), Ceramic (Alumina 92-99% purity), and Glass (Borosilicate and Silicate)

Physical Properties:

Density: 1.0±0.20 g/cm³

Dielectric Constant: 3±1

Thermal Conductivity: 0.15±0.25 W/m·K

Coefficient of Thermal Expansion (CTE): 8-20 ppm/°C

Young's Modulus: 0.30±1.0 GPa

Electrical Insulation Resistance: 10^{10}–10^{13} Ω·cm

Outgassing Treatment – All Getters have been baked out under 150°C for 1 hour for removing adsorbed gases and moisture.

Pre-installation Thermal Treatment: To remove adsorbed moisture and ambient gases, bakeout the getters in a vacuum at 100°C for 1 hour. Purging dry N_2 or Ar purge before assembly for re-adsorption of moisture prevention.

Environmental Conditions:

Max Operating Temperature Range: -55°C to 200°C

Storage conditions (e.g., temperature, humidity): room temperature and 30-50%RH

Shelf life:

- 5–10 years (in controlled storage conditions, such as a sealed dry environment at room temperature)
- 3–5 years (in moderate environmental conditions, such as ambient air exposure with some humidity fluctuations)
- <3 years (if exposed to high humidity, extreme temperatures, or reactive gases)

1. Safety Precautions

General safety

- Avoid inhalation of fine dust from the composite, as it may cause respiratory irritation.
- Use in a well-ventilated area or with proper extraction systems when handling porous materials.
- Minimize skin contact—some components may cause mild irritation.
- Avoid direct eye contact—particulate matter can cause mechanical irritation or dryness.

Fire & Thermal Safety

- Polymer may be combustible—avoid exposing the material to open flames or temperatures above 250°C.
- Use appropriate fire extinguishing methods: CO_2, dry chemical, or foam is recommended in case of fire.
- Thermal decomposition of material may release CO, CO_2, and VOCs, requiring proper ventilation.

Chemical Safety

- Moisture-sensitive components may degrade if exposed to prolonged high humidity—store in sealed containers.
- Avoid strong acids and bases, which can degrade the composite structure.
- Material may oxidize over time, potentially affecting electrical or magnetic properties.

2. Handling instructions

Material Handling

- Handle gently—the getter may be brittle and can fracture under mechanical stress.
- Use in dry conditions—avoid high humidity to maintain adsorption performance.
- Prevent electrostatic discharge (ESD)—if using in electronic applications, ensure proper grounding.
- Avoid direct mixing with solvents or reactive chemicals, as this may alter the composite properties.

3. Disposal Guidelines

General Disposal Considerations

- Do NOT dispose of in regular waste—the glass or ceramic substrate getter may require specific disposal procedures.
- Do NOT incinerate in uncontrolled environments, as burning may release harmful gases from the composite polymer.
- Check local regulations for disposal of silica-based and polymer composite materials.

Recommended Disposal Methods

- Collect in sealed bags and dispose of via industrial waste facilities.
- Follow local regulations for non-hazardous solid waste disposal.

Large amounts:

- Contact waste management services for proper disposal.
- If containing adsorbed contaminants (e.g., VOCs, gases), treat as chemical waste.

Typical Applications:

- Electronics Packaging: Acts primarily as a getter for moisture and other gases, VOCs, and particulate matter adsorptions.
- Thermal Barrier Coating: Provides insulation while maintaining lightweight properties.
- Catalyst Support: Can serve as a substrate for catalytic reactions.
- Gas Filtering Membranes: Due to its adsorption properties.

Compliance and Standards:

1. General Material Compliance

- REACH (EC 1907/2006, EU Regulation) – Ensures that the composite does not contain hazardous substances restricted under EU chemical regulations.
- RoHS (EU Directive 2011/65/EU & 2015/863/EU) – If used in electronics, the material should comply with restrictions on heavy metals (Pb, Hg, Cd, Cr(VI)) and certain flame retardants.
- California Proposition 65 (USA) – If sold in California, compliance with regulations regarding hazardous chemical content is necessary.
- TSCA (Toxic Substances Control Act, USA) – The composite should comply with US Environmental Protection Agency (EPA) chemical reporting requirements.
- ASTM & ISO Chemical Standards – Depending on chemical compositions and applications, relevant ASTM (American Society for Testing and Materials) and ISO (International Organization for Standardization) standards may apply.

2. Industry-Specific Standards

📌 **Electronics & Semiconductor Applications**

- IPC-4101 (Specification for Base Materials for Rigid and Multilayer Printed Boards) – If used in PCB or semiconductor packaging applications, materials must meet outgassing and moisture absorption requirements
- MIL-STD-883 (US Military Standard for Microelectronics Reliability Testing) – If used in hermetically sealed electronic packages, the material must meet particle contamination and moisture absorption criteria
- JEDEC JESD22-A120 (Silicone Contamination in Electronics) – Ensures compliance for use in semiconductor packaging
- IEC 60068-2 (Environmental Testing for Electronics) – Covers thermal cycling, humidity exposure, and outgassing properties.

📌 **Aerospace & Defense Applications**

- NASA ASTM E595 (Outgassing Test for Space Applications) – If the material is used in aerospace or satellite enclosures, it must meet low outgassing criteria.
- MIL-STD-810 (Environmental Testing for Military Equipment) – For extreme temperature and humidity conditions in defense applications
- SAE AMS (Aerospace Material Standards) – If used for spacecraft or avionics enclosures, adherence to aerospace-grade material standards is required.

📌 Medical & Biotech Applications

- ISO 10993 (Biocompatibility Testing for Medical Devices) – If the material is used in medical enclosures or implants, it must be tested for cytotoxicity, irritation, and sensitization.
- FDA 21 CFR Part 820 (Medical Device Quality System Regulations) – Compliance required if used in FDA-regulated medical devices.

📌 **Industrial Adsorption & Environmental Applications**

- ISO 9277 (Surface Area Determination for Adsorbents) – If used in gas adsorption applications, testing of specific surface area and pore size distribution is necessary
- ASTM D2854 (Total Surface Area of Porous Materials and Powders) – Determines adsorption efficiency
- ISO 16890 (Air Filter Testing Standards) – If used for air filtration or particulate matter removal

3. Mechanical & Thermal Property Compliance

- ASTM C1113 (Thermal Conductivity Testing for Insulating Materials) – Required if the composite is used for thermal insulation
- ASTM D638 (Tensile Testing of Polymers & Composites) – Determines mechanical strength and elasticity
- ASTM D696 (Coefficient of Thermal Expansion Testing) – If the material needs to meet specific thermal expansion requirements

4. Environmental, Health & Safety Compliance

- ISO 14001 (Environmental Management System) – Ensures eco-friendly production and disposal
- OSHA Hazard Communication Standard (29 CFR 1910.1200, USA) – If used in manufacturing, the material should have an SDS (Safety Data Sheet)
- GHS (Globally Harmonized System of Classification and Labelling of Chemicals) – Ensures proper labeling of chemical hazards

5. Fire & Flammability Compliance

- UL 94 (Flammability Testing for Plastics & Polymers) – If used in electronics or enclosures, the material must pass flame resistance tests
- NFPA 701 (Standard Methods of Fire Tests for Flame Propagation) – If used in fire-sensitive applications.
- ISO 1182 (Non-Combustibility Test for Materials) – If required for extreme temperature environments.

Version 3.0, July 12, 2025