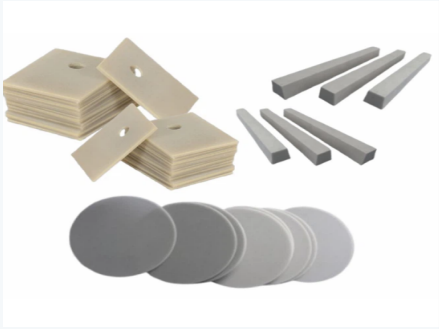
FREEWILL MATERIAL TECHNICAL DATASHEET

Aluminum Nitride (AlN)

Electrically insulating ceramic for high-efficiency thermal management.

Best suited for: Power electronics, semiconductor equipment, LED modules, heat spreaders and high-performance substrates.



Engineering Positioning

Aluminum Nitride is specified when a component must remove heat efficiently while maintaining electrical insulation. It is especially valuable where thermal bottlenecks reduce reliability, power density or process stability.

Typical Material Properties

Property	Typical engineering reference
Thermal conductivity	140-180 W/m-K typical, grade dependent
Dielectric strength	High electrical insulation, geometry dependent
Thermal expansion	About 4.5 x 10^-6/K
Flexural strength	300-400 MPa typical
Common forms	Substrates, plates, heat spreaders and custom machined parts
Key behavior	High heat transfer with electrical insulation

Values are typical reference ranges. Final data depends on grade, forming route, sintering process, geometry and test method.

Practical Application Scenarios

- Power module substrates, heat spreaders and insulated heat-dissipation plates.
- LED modules, laser diode packages and high-power electronic assemblies.
- Semiconductor process parts requiring thermal control and electrical insulation.
- Custom electronic ceramics where alumina cannot remove heat fast enough.

Selection Notes for Engineers

- Specify target thermal conductivity, dielectric requirement, thickness, metallization need and surface finish.
- Use AlN when heat must be transferred through an electrically insulating ceramic barrier.
- Compare against alumina when cost is critical and heat flux is moderate.

Aluminum Nitride (AlN) - Cost and Application Review

The lowest unit price is not always the lowest operating cost. For severe-duty ceramic components, cost should be evaluated by service life, downtime, contamination risk, replacement labor and process stability.

Example Lifecycle Cost-Saving Model

Item	Illustrative scenario
Current solution	Alumina substrate keeps device temperature near 118 C at peak load
AlN scenario	AlN substrate reduces modeled device temperature to about 102 C
Simple model	Lower thermal stress reduces failure/rework from 4.0% to 1.5% on a USD 80,000 batch
Estimated annual impact	USD 3,200 to USD 1,200 rework exposure per batch, about 62% lower in this example

This model is illustrative, not a guaranteed saving. Actual savings depend on operating conditions, design, installation, maintenance behavior and process value per hour.

Recommended Information to Share for Quotation

- Drawing, sketch, sample photo or target geometry.
- Working temperature, thermal cycle rate and atmosphere.
- Chemical medium, abrasive particles, pressure, speed and load.
- Current material, failure mode and expected service life.
- Required tolerance, surface finish, purity, quantity and delivery target.

Why Work with Freewill Material

Material selection	Recommendation based on operating conditions, not only material names.
Custom manufacturing	Ceramic and refractory components from drawings, samples or application requirements.
Technical communication	Support for engineers and procurement teams during sample, testing and volume production.
Global customer focus	English technical content, downloadable datasheets and application-oriented inquiry support.

Contact

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Ask for an expert material recommendation and include your working condition details for faster review.