Boron Nitride Products

for

Thermal Solutions

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TOPSPIN DESIGN (TSD) INTRODUCTION

TopSpin Resources, Ltd. was formed by a group of intelligent/ambition man's leading by Stanley Liu in 1997. TopSpin main business was to design and manufacture golf heads mainly for U.S. territory. Some of the success company projects' were Ruger, Tegra Golf, Carbit Golf and E-Club.

In 2001 **TopSpin Design Co., Ltd.** (TSD) was formed in U.S.A. by Stanley Liu base in Los Angles, California involving in development of boron nitride powders. TSD also established brand name "TSD" targeted to preparing for the launching hexagonal Boron Nitride related products in the nearest future.

In 2004 the boron nitride production was successfully announced. TopSpin Design L.A. office was relocated to Taiwan and merged with TopSpin Resources, Ltd. and renamed as TopSpin Design Co., Ltd. (TSD). TSD teamed up with NNT run by Kent Chu (Stanley's cousin) concertrated for hexagonal boron nitride powder productions. TSD carry's out the task in responsible for Boron Nitride thermal solution products worldwide.

Company:	TopSpin Design Co.
Name:	Stanley Liu
Position:	President, CEO for TopSpin Design Co.
Education:	B.S. Business Management; Minor in Economics
Business Experience:	Automotive Engineering; Automotive Manufacturing; Golf Club Design & Manufacturing; Material Engineering; World Wide Marketing

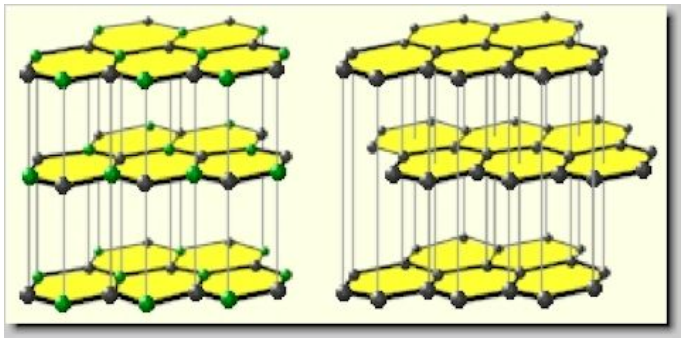
HEXAGONAL BORON NITRIDE INTRODUCTION

Background

Boron nitride is a synthetic material, which although discovered in the early 19th century was not developed as a commercial material until the latter half of the 20th century. Boron and nitrogen are neighbors of carbon in the periodic table - in combination boron and nitrogen have the same number of outer shell electrons - the atomic radii of boron and nitrogen are similar to that of carbon. It is not surprising therefore that boron nitride and carbon exhibit similarity in their crystal structure.

The chemical combination of boron and nitrogen does not occur in nature. The properties, manufacture and applications is one of the key advanced ceramic in modern technology.

Hexagonal boron nitride (h-BN) crystallizes like graphite in a layer lattice and is therefore often called "white graphite". Its very good thermal (high melting- or sublimation point and good thermal shock stability) and physical characteristics (good electrical insulator, good heat conductivity and good high temperature lubrication qualities) make it an interesting ceramic material. One of the most well-known characteristics of hexagonal boron nitride is the very bad wettability by metal melts (like Al, Mg, Zn, Pb and Cu), slags as well as salt melts. Boron nitride is stable at air to approx. 1000°C, under reduced conditions or inert gases it can be used up to 1800°C.



Crystal lattice of hexagonal boron nitride (left) and graphite (right). Because boron nitride and graphite show similar layer structures, boron nitride is often called "white graphite".

Key Properties

Hexagonal boron nitride possesses such outstanding characteristics as density of only 2.27 g/cu cm, a 2600℃ melting point, high chemical inertness and corrosion resistance, stability in air to 1000℃, resistance to thermal shock, high electrical insulation value, and high thermal conductivity (above 700℃, this exceeds the conductivity of BeO).

- ✓ High thermal conductivity
- ✓ Increase performance and reliability by thermal management
- ✓ Excellent radiated heat transfer
- ✓ Low thermal resistivity and expansion
- ✓ Low dielectric constant and loss tangent
- ✓ Increasing air/surface cooling areas
- ✓ Non toxic
- ✓ Good thermal shock resistance
- ✓ Microwave transparency
- ✓ Chemically inert, corrosion and oxidization resistance
- ✓ Excellent lubrication properties with low coefficient in wide temperature
- ✓ Withstand high temperature (up to 2600°C)
- ✓ Non-wetting surface protection layer coat
- ✓ Good chemical inertness

Applications

Thermal Coating

TSD BN coating provides excellent thermal conductivity and excellent “heat spreading” capability for improved temperature uniformity. The combination of high dielectric, good thermal conductivity, excellent radiated thermal property, and low thermal resistance

The TSD BN thermal coating found wide acceptance in the semiconductor, electronics, motor vehicles, and industrial equipment.

Thermal Grease

The BN grease provides low thermal resistance and thermal stability for CPU, GPU, power components. With a 2.47 W/mK, the TSD thermal grease wets thermal surfaces to crease a very low thermal resistance.

Thermal Pads

The BN thermal pads offer another solution to thermal interface material achieving 2.47 W/mK thermal conductivity.

Electrical Insulators

The combination of high dielectric breakdown strength and volume resistivity lead to h-BN being used as an electrical insulator however its’ tendency to oxidize at high temperatures often restrict its use to vacuum and inert atmosphere operation.

Solids

hBN hot pressed solids is used for substrates for mounting high density and high power electronic components where the high thermal conductivity achieved allows efficient heat dissipation.

High Temperature Fire Resistance BN Grease

TSD High Temperature Fire Resistance BN grease offers superb lubrication withstands high temperature (up to 600℃) with constant low coefficient throughout the temperature changes.

The TSD BN thermal coating found wide acceptance in the aviation, automotive, electronics, and digital cameras.

Oil Additive

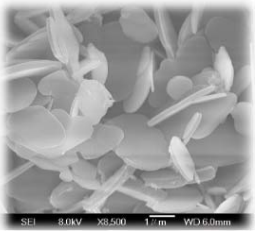
TSD BN oil additive specially formulated nano hBN providing low friction and thermal stability for motor oils.

BN Thermal Coating Products

Advantages

TSD BN thermal coating forming a unique layer of highly thermal conductive boron nitrides on object surfaces. The object can be any materials such as cooper, aluminum, plastic, and composite materials.

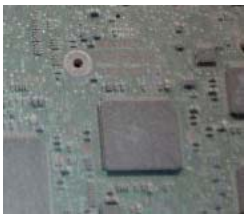
Applying the TSD BN thermal coating is most affective to extra heat from the heat source. The heat is quickly directed away and cooled by temperature differences and radiation.



In addition, the BN thermal coating surface will form "white graphite" like protection layer again oxidation. The increase surface area extended by the hBN will effective allows more air-surface contact and heat radiation cooling.

Features and Benefits

- High thermal conductivity of 100~250 W/mK
- Low thermal resistance
- Low dielectric constant and loss tangent
- Excellent radiated heat transfer
- Low dielectric constant
- Easy to use

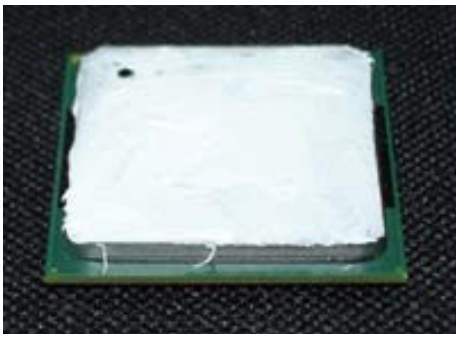


Applications

- Heat sinks
- Heat exchangers
- PCB boards
- Power components
- High power LED housings
- Thermal modules
- Turbo chargers
- Furnaces
- Engines
- Motorcycle/scooter CVT components
- High temperature components
- Surface protection

BN Thermal Grease

Advantage



The BN grease provides low thermal resistance and thermal stability for CPU, GPU, power components.

TSD BN thermal grease provides high thermal conductivities, minimum bond-line thickness and superior surface wetting.

The unique BN composition offers low thermal resistances and outstand reliability. The BN thermal greases do not dry out or pump-out and remain stable.

Features and Benefits

- High thermal conductivity of 2.47 W/mK
- Low thermal resistance
- Low dielectric constant and loss tangent

Applications

- CPUs for desktop and notebook computers and servers
- GPUs
- Chipsets
- Power components

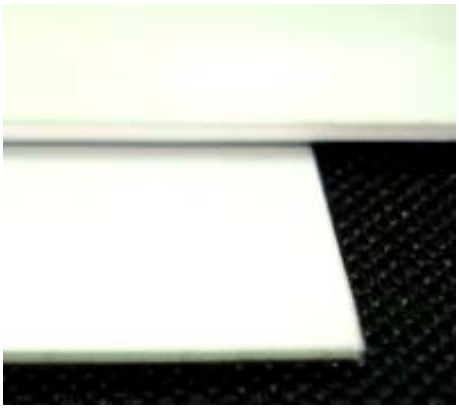
Specifications

Thermal conductivity:	2.47 W/mK
Thermal resistance:	Very low

BN Thermal Pads

Advantage

The BN thermal pads offer another solution to thermal interface material achieving 2.47 W/mK thermal conductivity.



Features and Benefits

- High thermal conductivity of 4.47 W/mK
- Low thermal resistance
- Thickness – Varies from 0.45mm ~ 1.5mm

Applications

- Power conversion equipment
- Power components
- Notebook computers
- CPU
- GPU

BN Solids

Advantages

hBN hot pressed solids is used for substrates for mounting high density and high power electronic components where the high thermal conductivity achieved allows efficient heat dissipation.

Hot-pressed BN is compacted at temperatures up to 2000℃. Currently TSD offers low pressure hot-pressed BN, but will soon offering height pressure hot-pressed BN. Hot-pressed BN can result in limited thermal shock resistance.

In addition, the characteristics of powdered hexagonal boron nitride are:

- ✓ High thermal conductivity
- ✓ High thermal shock resistance
- ✓ Chemically inert
- ✓ Excellent radiated heat transfer
- ✓ High electrical resistance
- ✓ Corrosion and oxidization resistance
- ✓ Low loss tangent and low dielectric constant

Applications

- Heat sink in transistor packages
- Insulators

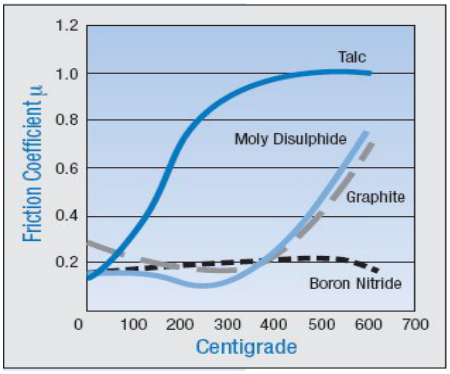
General Specification

	Boron nitride	Aluminum oxide
Dielectric constant	4.2	9.7
Thermal conductivity at RT W/mK	55~70	33

High Temperature Fire Resistance BN Grease

Advantages

Unlike any other grease on the market, TSD high temperature fire resistance BN grease able to withstand high temperature working environment. When the high temperature BN grease expose more than 180℃, the grease composite evaporates leaving boron nitride as dry lubricant substance. Boron nitride able to withstand high temperature over 1000℃ and maintaining friction coefficient of 0.2u ~ 0.3u.



- ✓ Withstand high temperature
- ✓ Reduce friction
- ✓ Chemically inert, corrosion and oxidization resistance
- ✓ Reduce thermal expansion
- ✓ Improve thermal shock resistance
- ✓ Excellent thermal conductivity
- ✓ Excellent lubrication properties with low coefficient in wide temperature

Applications

- ■ Aviation
- ■ Automotive
- ■ Motorcycle
- ■ Industrial
- ■ Digital Camera
- ■ Bearing
- ■ Electric motor components
- ■ High speed rotation devices
- ■ Kilns
- ■ Soot Blowers

Specification Typical

Auto ignition Temp.°F Min	ASTM D286-58T	1150
Dropping Point °F		None
Four Ball Wear Test Scar Diam. Mm	ASTM D-2266	0.6
011 Separation % Loss	FTM-321	3.0
Oxidation Stability	ASTM D-942	2
Penetration @77°F Worked		270

Seals

Known Compatibility

Viton
PTEE
Silicon Rubber
Buty1 Rubber
EPR Rubber
Leather
Fiber
Nylon
Factory Mutual Approval-Bureau of Mines Approval

Unknown Compatibility

Neoprene
Buna N
Natural Rubber

BN Motor Oil SAE 10W-40

Advantages

Nano boron nitride superb low friction coefficient of 0.2u ~ 0.3u in high temperature ranges provides best element additive for the motor oil.

TSD formulated most advanced boron nitride additive with synthetic motor oil providing best lubrication and engine protection at highest engine demand.

- ✓ Protects engine
- ✓ Easier cold start
- ✓ Excellent lubrication
- ✓ Decrease engine noise
- ✓ Reduce fuel consumption
- ✓ Excellent thermal management
- ✓ Increase horse power and torque
- ✓ Reduce engine components friction

Specification Typical

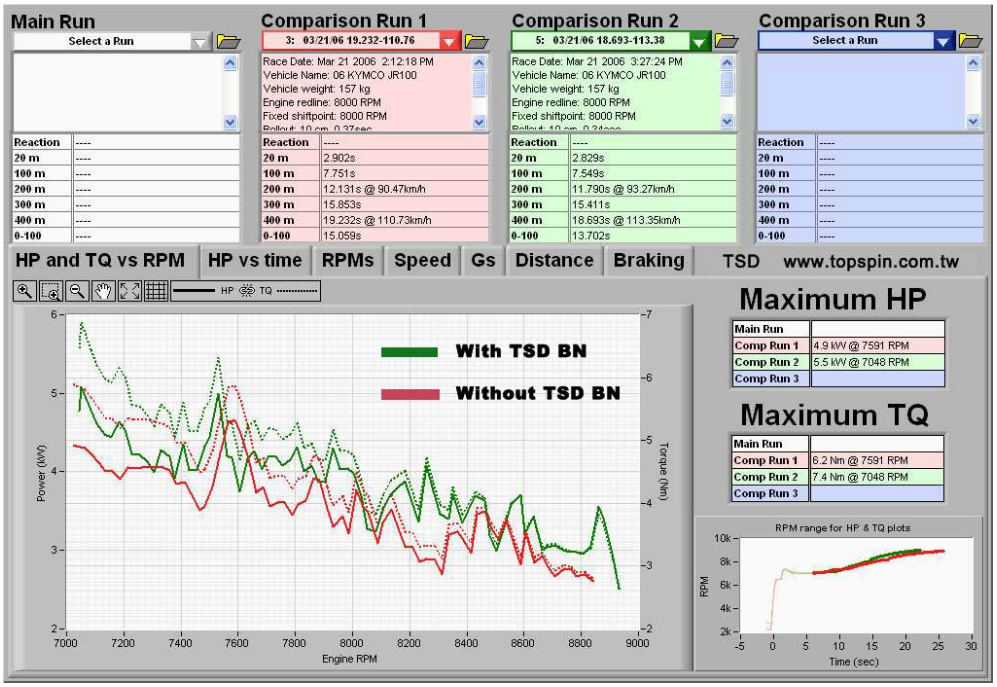
Specification:	SAE 10W-40, API SL
Production date:	On the bottle
Expiration date:	5 years
Main ingredients:	Leading brand synthetic motor oil and TSD nano Boron Nitride additive
Application:	4-T engine
Instruction:	Following factory oil change instruction
Packed by:	TopSpin Design Co.
Volume:	1 Liter

Performance Test

Test Date:	March 21, 2006
Test Equipment:	G-Tech Pro RR
Test Vehicle:	Model: 2006 Kymco JR100 Stock
	Weight: 157 KG (total weight including rider)
Fuel Used:	CPP 95 octane premium unleaded
Motor Oil:	Castrol Activ 10W-40 4-stroke Motor Oil
Oil Additive:	TSD Boron Nitride Thermal Coating

HP increase with TSD BN Oil additive:	12%
Torque increase with TSD BN Oil additive:	19%

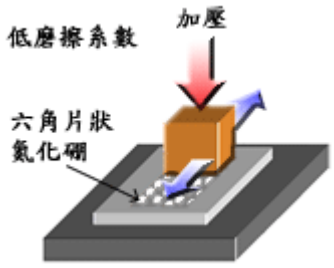
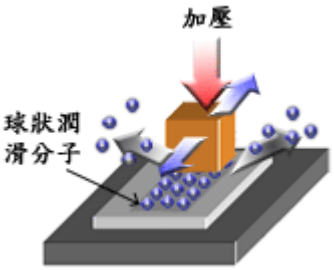
ITEM		MOTOR OIL	WITH BN
HP	Metric	4.9 kW @ 7591 RPM	5.5 KW @ 7048 RPM
	US	6.6 HP @ 7591 RPM	7.4 HP @ 7048 RPM
Torque	Metric	6.2 Nm @ 7591 RPM	7.4 Nm @ 7048 RPM
	US	4.6 ft-lbs @ 7591 RPM	5.5 ft-lb @ 7048 RPM
Acceleration	0-40 km/h	2.629s	2.485s
	0-60 km/h	5.291s	4.923s
	0-80 km/h	9.342s	8.529s
	0-100 km/h	15.097s	13.702s (1.3s quicker)
	0-120 km/h	23.889s	22.116s
	40-80 km/h	6.713s	6.044s
	60-100 km/h	9.806s	8.786s
	80-120 km/h	14.547s	13.587s
0-400 meter		19.232s @ 110.73km/h	18.693s @ 113.35km/h
Highest RPM		8903	9203



BN Oil Additive

Advantages

TSD BN Oil Additive has unique formulation exceed competitor performance. TSD utilize boron nitride and titanium nano-oxide to be the major additive ingredients.

TSD BN Oil Additive is formulated with unique friction properties. Utilizing the hexagonal bn flake is act as super slick plate between two surfaces that has no wear and result in co-efficient and friction temperature reduction. Plate friction is known to provide better torque and less wear than any of the round spherical shape particles. Less friction meaning more power and less heat generated.	
Other Lubrication Particles are generally group into spherical shape particles, which are most commonly used in lubrication. When the torque is being applied, the spherical particles will be squeeze away that result poor lubrication and increase friction and wear. Image that if you lay ping balls on the ground, initially they become very slippery, but they will squeeze away as soon as you step on them.	

The wear also accelerated as the contact point of the ball tend to indent the surfaces that cause unwanted wear inside the engine.

※Unmatched performance

The advantage of the BN use in additive provides un-matched inorganic lubricating power that give an indefinite life.

SPECIFICATION	
Boron Nitride nano particles	奈米氮化硼
Ti-nanoxide	奈米液鈦

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