

# Nevada Thermal Spray Technologies (NTST) 070324

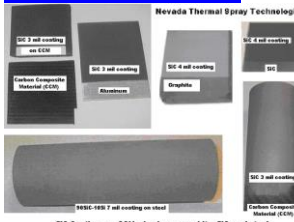
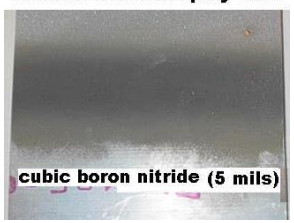
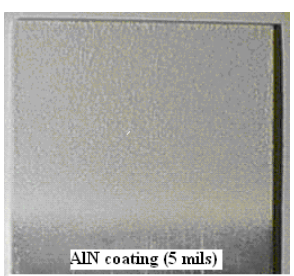

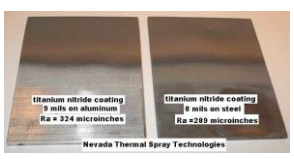
## NEW NTST PRODUCTS

NTST website: [www.nevadathermalspray.com](http://www.nevadathermalspray.com)

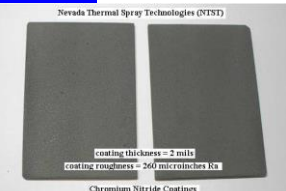
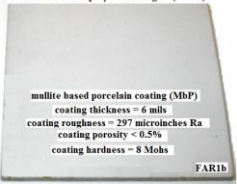
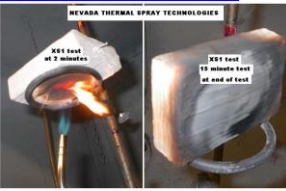
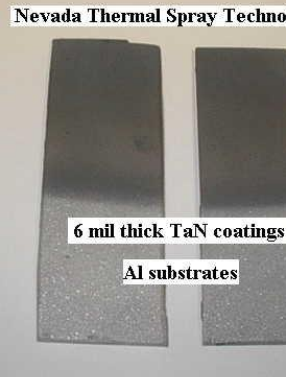
contact: Dominic 702-449-2154

	<p>NTST specializes in thermal spray coatings, materials technology, and process technology. The company conducts production and R&amp;D tasks for government and industry. NTST centers on a core competency of superior customer service which involves fabricating a world class custom product that lowers ultimate lifecycle costs at the most diminished lead times in the industry.</p>
<p><u>LATEST NTST PRODUCTS:</u></p>	<p>Thirteen new NTST products are now available for many industrial applications. These include coatings of boron carbide (B4C), silicon carbide (SiC), aluminum nitride (AlN), silicon nitride (Si3N4), titanium nitride (TiN), chromium nitride (CrN), zirconium nitride (ZrN), mullite based porcelain, ceramic fire protection, tantalum nitride (TaN) and titanium diboride (TiB2). To our knowledge, NTST is the first to fabricate thermal spray coatings of the majority of these materials.</p>
<p><u>1 Titanium Diboride</u></p> 	<p>TiB2 is a ceramic that has a high hardness, low density, high melting point, good electrical conductivity, and good wear and corrosion resistance. TiB2 coatings possess high heat resistance and are unaffected by acid or alkaline solutions. Typical applications include nuclear, fossil and geothermal energy environments, cutting tools, and textile components.</p>
<p><u>2 Zirconium Nitride</u></p> 	<p>Zirconium nitride is a hard ceramic material similar to <b>titanium nitride</b> and is considered a <b>refractory</b> material. When applied as a coating, it is commonly used for medical devices,<sup>1</sup> industrial parts (i.e., <b>drill bits</b>), automotive and aerospace components and other parts subject to high wear and corrosive environments. Zirconium nitride has been used in applications for rockets and aircraft.</p>
<p><u>3 Boron Carbide</u></p> 	<p>B4C is an excellent wear coating for industry. B4C is the hardest material next to diamond. The coatings possess high heat resistance, are unaffected by acid or alkaline solutions, and possess excellent anti-galling properties. NTST can fabricate pure B4C coatings, B4C cermets (B4C+Ti, B4C+Ni), and B4C-SiC composites. Maximum coating thickness: 45 mils.</p>
<p><u>4 h-Boron Nitride</u></p> 	<p>Hexagonal-BN is the most stable and softest among BN polymorphs. It combines such features as high-temperature lubricity, electrical insulation, thermal conduction, and chemical inertness. Major industries using h-BN include the aircraft, aerospace, chemical, military, paper, power, printing, and steel industries. Maximum coating thickness: 20 mils.</p>

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<p><b><u>5 Silicon Carbide</u></b></p>  <p>Nevada Thermal Spray Technologies</p> <p>SiC Coatings on CCM, aluminum, graphite, SiC, and steel</p>	<p>SiC is an excellent choice for dual wear-corrosion mitigation applications due to its unique properties of low density, high strength, and excellent resistance to corrosion (i.e. alkaline and acidic). SiC is the third hardest material after diamond. It is the perfect coating for protecting carbon composite materials from degradation. Maximum coating thickness: 3 mils.</p>
<p><b><u>6 c-Boron Nitride</u></b></p>  <p>Nevada Thermal Spray Tech</p> <p>cubic boron nitride (5 mils)</p>	<p>The crystal structure of c-BN is analogous to diamond. This material has hardness slightly lower than diamond but its thermal and chemical stability is superior. c-BN surpasses diamond in mechanical applications. The benefits of c-BN include intermediate density, high thermal conductivity, high temperature stability and strength, low coefficient of thermal expansion, corrosion and oxidation resistance, excellent thermal shock resistance, and low dielectric constant. The superior mechanical properties make it usable as a wear coating. Maximum coating thickness: 7 mils.</p>
<p><b><u>7 Aluminum Nitride</u></b></p>  <p>Nevada Thermal Spray Tech</p> <p>AlN coating (5 mils)</p>	<p>AlN coatings possess an ideal combination of material properties for use in electronic applications. These coatings can be used on a variety of different substrates (e.g. aluminum, steel, aluminum nitride). The coatings are stable at high service temperatures, exhibit very high thermal conductivity, and are resistant to attack from most molten salts. Applications include: opto-electronic, dielectric, electronic substrates, military applications, crucibles, and semiconductor and steel manufacturing. Maximum coating thickness: 10 mils.</p>
<p><b><u>8 Silicon Nitride</u></b></p>  <p>Si3N4 coating (10 mils)</p>	<p>Si3N4 is a high-melting point solid that is relatively chemically inert and very hard (8.5 on the Mohs scale). Silicon nitride has better high temperature capabilities than most metals. Benefits include low density, high temperature strength, superior thermal shock resistance, excellent wear resistance, and high hardness and toughness. Maximum coating thickness: 10 mils.</p>
<p><b><u>9 Titanium Nitride</u></b></p>  <p>Nevada Thermal Spray Technologies</p> <p>Titanium nitride coating 15 mils on aluminum Ra = 324 microinches</p> <p>Titanium nitride coating 15 mils on steel Ra = 289 microinches</p>	<p>Titanium nitride (TiN) coatings possess an ideal combination of hardness, toughness, adhesion, and inertness. These coatings can be used on a variety of different substrates. The coatings have a high service temperature, are electrically conductive, non-oxidizing, and resistant to most chemicals. TiN can be used in applications to eliminate galling, fretting, wear, and low friction. Most materials will not adhere to TiN. Maximum coating thickness: 15 mils.</p>

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<p><b><u>10Chromium Nitride</u></b></p> 	<p>Chromium nitride coatings are used as a coating material for corrosion and wear resistance. The coatings possess the greatest adhesion and ductility of all nitride coatings. The coatings can be used on a variety of different substrates including stainless steel, carbon steel, aluminum, brass, and copper.</p>
<p><b><u>11MullitePorcelain</u></b></p> 	<p>Properties associated with NTST MbP (i.e., mullite based porcelain) coatings include low porosity, high resistance to chemical attack, low density, low permeability, high temperature strength, hardness, toughness, good wear resistance, and good thermal shock resistance. Key properties are a low thermal expansion coefficient, low thermal conductivity, and high material stability.</p>
<p><b><u>12.FireProtection</u></b></p> 	<p>NTST has developed a green, non-intumescent, ceramic based paint system that can be used for any underlying substrate to mitigate the hazard of fire. This coating system meets testing standards for temperature and moisture exposure. It is the most economical fire prevention product in the marketplace.</p>
<p><b><u>13.TantalumNitride</u></b></p> 	<p>TaN is hard, oxidation resistant, and chemically inert. The powder varies from brown to black with a crystal structure based on nitrogen composition. TaN has been widely used in the mechanical and microelectronics industries. TaN films and coatings exhibit good wear resistance, high hardness, corrosion resistance, and stable electrical resistivity. TaN finds application as a protective coating due to its excellent wear properties. It has found use as a diffusion barrier and insulating layer between copper interconnects in integrated circuit manufacture of computer chips. TaN is insoluble in water. Tantalum and its compounds are renowned for their resistance to corrosion by acids.</p>

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### NTST Materials Information:

Materials information listed below is taken from various sources. This includes coating, thin film, and free form data. These listed properties are only approximate, and vary substantially for thermal spray coatings. Further materials characterization needs to be conducted on these coatings for each customer's unique application.

Mat	Hard Mohs	Rough microin	Decomp T F (K)	Density Kg/m <sup>3</sup>	TherCond W/m-K	CTE C	Dielec Const	DielecStren V/mil
B4C	9.5	Rz1766 Ra 375	5005 (3036)	2520	30-42	5	4.8	127-254
SiC	9.2	Rz 798 Ra 175	4946 (3003)	3100	30-150	4.5	9.7	
hBN	1.5	Rz1293 Ra 305	4040 (2500)	2280	27	1-4	4	889
Si <sub>3</sub> N <sub>4</sub>	8.5	Rz1716 Ra 343	3452 (2173)	3250	43	3.7	10.5	304-420
cTiN	9.1	Rz1694 Ra 325	5301 (3200)	5440	19.3	9	2-12	
cBN	10	Rz1525 Ra 305	4040 (2500)	2200 3450	27	3.8	4.1	889
AlN	7	Rz1595 Ra 319	3990 (2470)	3260	140	4.5	9	200
ZrN	>9 2900V	Rz1425 Ra 302	5346 (3225)	7090	20	7.2	---	
CrN			2731 (1773)	5900				
MbP	8	Ra 297		2800	3.5	5.5	6	
TiB <sub>2</sub>	9.3	Ra 330	3189 mp	4450	24	6	-----	200

**B4C:** wear coating, 2<sup>nd</sup> hardest material, mitigate wear by abrasive grains, hard surfaces, particle erosion, and cavitation, high heat resistance, unaffected by acid or alkaline solutions, excellent lubrication, anti-galling, FDA approved, nuclear apps.

**SiC:** oxidation protection of CCMs, heat exchangers, refractory materials, wear applications (pump seals, shafts, valves), thermal shock resistance.

**hBN:** thermal shock resistance, refractory heat transfer surfaces, dissipate heat, maintain electrical isolation, insulator, refractory wall liners, crucibles, nozzles, radar components, radome coatings, microwave windows, clearance control.

**Si<sub>3</sub>N<sub>4</sub>:** automotive, industrial bearing, aerospace, medical, electronics, automotive engines, wear components, glow plugs, combustion chambers, turbochargers, exhaust gas control valves, low friction, high stiffness.

**cTiN:** hard, tough, adhesive, inert, high service temperature, electrically conductive, non-oxidizing, chemically resistant, eliminates galling, fretting, wear, low friction.

**cBN:** crystal structure analogous to diamond, high hardness, superior thermal and chemical stability, intermediate density, high thermal conductivity, high T stability

## **Nevada Thermal Spray Technologies (NTST) 070324**

and strength, low CTE, corrosion and oxidation resistance, excellent thermal shock resistance, electrical insulator, low dielectric constant, resistance to fracture, erosion, abrasion, and wear.

**AlN:** high thermal conductivity, high service temperatures, high thermal conductivity, resistant to attack from most molten salts, electronic applications, dielectric applications.

**ZrN:** developed to perform in areas that TiN has proven unsuccessful, low deposition temperature, excellent corrosion resistance, high lubricity, and hardness. Maximum operating temperature of 1100F (600C).

**CrN:** hard, excellent bond strength, chemically inert, low service temperature, wear and corrosion resistant.

**MbP:** low thermal expansion coefficient, low thermal conductivity, high material stability, hard, and wear resistant.

**TiB<sub>2</sub>:** high heat resistance, unaffected by acid or alkaline solutions, good lubrication and anti-galling properties.

**TaN:** hard, oxidation resistant, chemically inert, widely used in the mechanical and microelectronics industries, insoluble in water,