

Physical Properties of Titanium Nitride (TiN) Coatings

Composition	TiN. > 99 % purity.
Process	PVD Vacuum Deposited Coating.
Appearance	Metallic Gold.
Thickness	Ranges from 0.25 to 12 microns. Typical applications are 1 to 5 microns. See the thickness conversion chart.
Uniformity	Coating conforms uniformly to the substrate. No buildup occurs on corners (unlike plating operations). Coating "throws" well into features. In deep holes, coating tapers off from 1 to 7 diameters of depth.
Hardness	Hardness > 2000 kg/mm ² Knoop or Vickers Microhardness. Values of 2500-3000 are typical. Equivalent to over 85 Rc. Three times harder than hard chrome and harder than carbide material.
Adhesion	The coating forms a metallurgical bond to the substrate that will not flake, blister, chip or peel. In fact, the coating is actually implanted slightly into the surface layer of the substrate. Adhesion is superior to plating and other coating processes where mechanical adhesion occurs. Several adhesion test methods are possible, contact BryCoat for more info.
Adhesion, Scratch Adhesion Value	> 3.0 kgf on hard steel substrates
Coefficient of Friction	TiN generally provides low friction against steels, carbides, TiN, ceramics, platings, etc. Published values range from 0.05 to 0.90. A typical value is 0.6 for TiN against steel. The inert surface creates outstanding sliding wear performance. <u>Note:</u> The coefficient of friction is a system property, not a material property. It is dependant on many factors such as material, counter-material, lubrication, temperature, speed, loading force, surface finish, surface finish of the counter-material, and type of motion (reciprocating, rotating). Published values can have large variations.
Non-stick	TiN is an excellent non-stick surface against most other materials.
Toxicity	Non-toxic. Meets FDA guidelines and has been approved for use in numerous medical/surgical devices, including implants. Meets requirements of FDA and USDA for food contact.
Temperature Resistance	Begins to oxidize at 600 °C. (1100 °F.) in air. More resistant in an inert atmosphere.
Melting Temperature	2950 °C.
Deposition Temperature	Ranges from 200 to 450 °C. Standard process is 400 °C. and provides the toughest coating. See also the temperature reference page.
Electrical Resistivity	25 μOhm-cm. To determine resistance, multiply by length and divide by cross sectional area.
Chemical Resistance	Highly inert to acids, bases, solvents, caustic, etc.
Thermal Expansion Coefficient	9.4 x 10 ⁻⁶ / °C.
Thermal Conductivity	0.046 Cal/sec.-cm-°C.
Density	5.22 g/cm ³ .
Crystal Structure	Face Centered Cubic.
Residual Compressive Stress	xxx
Young's Modulus, Modulus of Elasticity	600 GPa.
Poisson's Ratio	0.25
Heat of Formation	80,750 Cal/mole. (3.5 eV/molecule).
Band Gap	3.35 - 3.45 eV