

Infinium Coatings Application Guide



Cutting Tools	Black Widow	Infinium					Diamond
	DLC	A	C	E	T	Z	D
Material Being Machined							
Carbon Steel		✓	✓		✓		
Alloy Steel		✓	✓		✓		
Hardened Alloy Steel		✓	✓		✓		
Stainless Steel		✓	✓		✓		
Cast Iron		✓	✓		✓		
Wrought Aluminum	✓					✓	
Cast Aluminum <12% Si	✓						✓
Cast Aluminum >12% Si	✓						✓
Titanium		✓	✓				
Nickle Based Alloys		✓	✓				
Kovar		✓			✓		
Copper Alloys	✓	✓		✓			
Brass/Bronze			✓	✓			
Graphite	✓						✓
Carbon/Glass Composite	✓						✓

Applications

Forming and Stamping Dies			✓	✓	✓		
Forging and Extrusion Dies		✓		✓	✓		
Die Casting Molds		✓	✓	✓			
Plastic Molds (Abrasion Resistance)	✓	✓		✓	✓		
Plastic Molds (Corrosion Resistance)	✓			✓	✓		
Plastic Molds (Release Problems)	✓			✓	✓		
Automotive Poor Lubrication Applications	✓			✓	✓		
Automotive High Temperature Corrosion Resistance		✓					

Coating Properties

Property	Black Widow	Infinium					Diamond	
	DLC	A	C	E	T	Z	Standard	Smooth
Microhardness (HV)	2000-4000	3000-3700	3000-3700	2100-2500	2500-3000	2200-2600	>8000	>8000
Coefficient of Friction*	0.1-0.05	0.4	0.4	0.5	0.5	0.5	0.05-0.7	0.05-0.2
Thickness (um)	1-2	1-4	1-4	1-4	1-4	1-4	5-30	4-20
Oxidation Temperature (°C)	450	900	400	650	500	550	800	800
Color	black/gray	violet-black	grey, copper	silver	gold	bright gold	silver/gray	glossy gray
Coating Temperature (°C)	100-150	400-620	400-620	300-550	400-550	400-550	700-800	700-800

*against steel (dry)

How hard is hard?

Steel at 60Rc is 697HV, steel at 80Rc is 1865HV, C-2 Carbide is 1700HV, TiN is 2500HV, and diamond is 8000HV.



DLC Hard Carbon Coatings

Our Black Widow DLC coating is tailored to have a combination of lubricity, abrasion, and corrosion resistance. Being a type of dry lubricant film, it performs well in bearing and gear applications where two mating surfaces have sliding contact. On cutting tools, DLC has worked very well with abrasive material such as wood and aluminum. Black in color and resistant to fingerprinting, this is also an ideal coating for cosmetic purposes.

In general, HCCs have a low coefficient of friction and good chemical resistance. The hardness of an HCC can be tailored to match a specific application.

Hard Carbon Applications

Cutting Tools

- Reduces cutting forces and chip welding
- Increases wear resistance in abrasive materials
- Excellent for wood working

Forming Tools

- Forming dies and punches
- Reduces abrasive wear and friction
- Best in forming operations kept below 400°C

Automotive

- Improves component lifetime
- Reduces friction and lubrication needs
- Increases power and improves fuel efficiency

- Improves run-in times
- Reduces sliding friction
- Prevents seizure in dry conditions

Medical

- Maintains cell integrity with no inflammatory response
- Excellent biocompatibility with prosthetics, catheters, and implants
- Increased lifetime of medical instruments

General

- Decorative applications
- Easy to clean



Infinium A

Infinium A is a multilayer Aluminum Titanium Nitride (ALTiN) based coating. The development of PVD Aluminum Titanium Nitride based coatings is the most significant advancement in wear coatings since the introduction of Titanium Nitride. The addition of aluminum to the coating not only increases cold and hot hardness, but also can double the maximum operating temperature of Infinium A coated components. The aluminum in the Infinium A converts to aluminum oxide from the heat in these high temperature applications creating a ceramic layer in the coating. The oxidation onset temperature for Infinium A is 900°C, which is one of the highest commercially available oxidation temperatures for a PVD coating.

Infinium A has a violet black color and its hardness properties can be tailored by varying the aluminum content of the coating.

Infinium A Applications

Cutting Tools

- Dry machining of hardened steels
- Machining of materials with a hardness greater than 50 Rc
- Titanium, inconel, and stainless steels can be machined at higher speeds
- Requires heat to work

Automotive

- A wear and oxidation barrier on parts subjected to exhaust gases

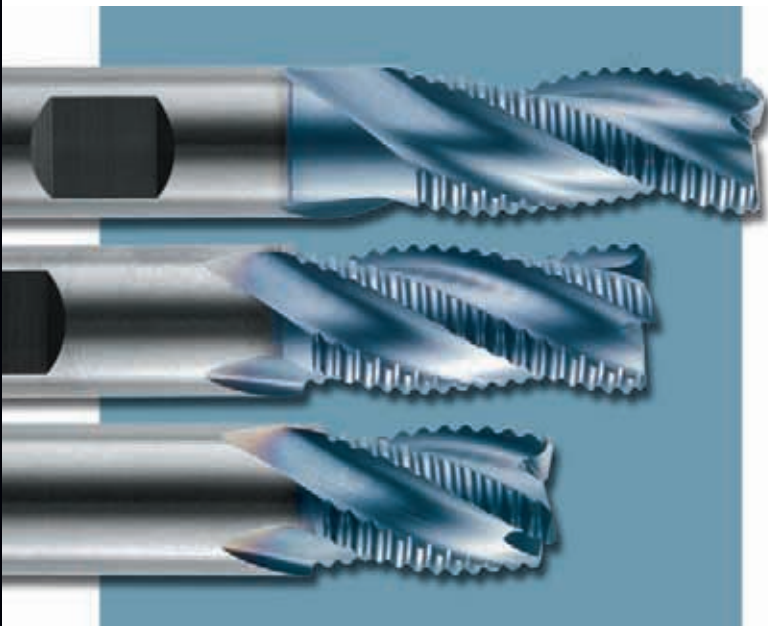
General

- A general purpose wear coating
- A beautiful, dark-colored decorative coating

Forming Tools

- Protective coating for moderate to high temperature dies and molds
- Protects tools from wear, heat checking and thermal fatigue





Infinium C

Introducing a carbon bearing gas to the Infinium T deposition process creates PVD Infinium C, Titanium Carbonitride (TiCN). The incorporation of carbon into the film increases its hardness and wear resistance, while lowering its coefficient of friction from the properties of Infinium T. These properties yield significant lifetime improvement in comparison to Infinium T coatings. Due to its increase in brittleness, Infinium C is deposited as a multilayered coating to have adequate toughness for cutting applications.

Infinium C appearance can range from a near-gold appearance, to a copper color, to the silver-blue color typically found in the marketplace. The color depends on the carbon content and other coating processing factors in the composition of the final coating layer.

Infinium C Applications

Cutting Tools

- All cutting tool applications
- Performs well on titanium and nickel-based alloys
- Works well with coolants

Forming Tools

- Punches, shear blades and dies

General

- General purpose wear coating on parts subject to abrasive wear
- Range of colors available for decorative applications



Infinium E

Infinium E is a Chromium Nitride (CrN) based coating. Infinium E is a tough, wear resistant coating with exceptional corrosion resistance. It has higher oxidation resistance than Infinium T and Infinium C and, due to its chemical inertness, prevents adhesive wear.

Infinium E is silver in color and appears like polished stainless steel. It is an environmentally friendly coating and is harder than chrome plating.

Infinium E Applications

Cutting Tools

- Easier machining of difficult materials, such as copper and titanium

General

- Better wear properties
- Can be polished to have the appearance of hard chrome plating
- Use as a wear coating where increased toughness and corrosion resistance is required

Molds

- Injection molding – decreased wear and sticking of plastics

Automotive

- Corrosion-resistant coating for sliding parts

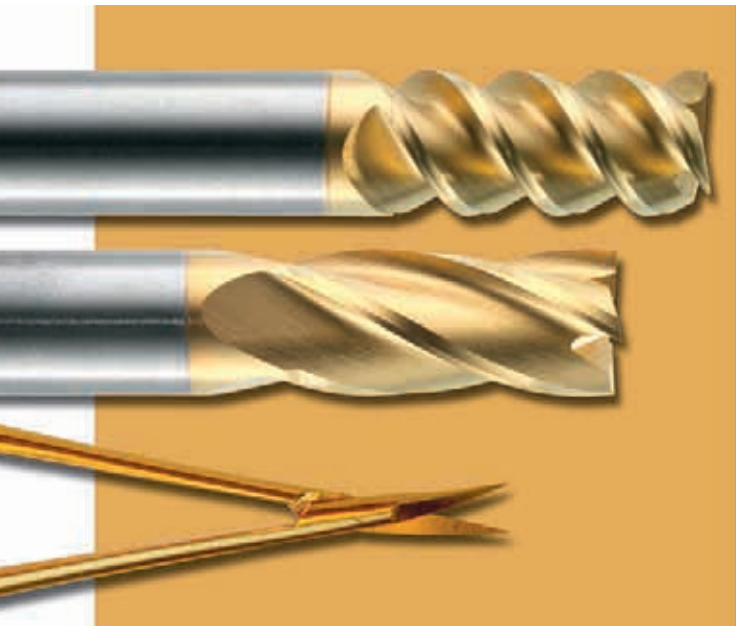
Medical

- Increased lifetime of components that need repeat sterilization
- Anti-corrosive and anti-sticking properties make it easier to maintain cleanliness and sterility of component
- Excellent biocompatibility
- External and internal medical devices

Forming Tools

- Improved forming tool life in dies
- Adhesion and shock resistance for high load applications
- Hot hardness and oxidation resistance for hot forging applications
- Flanging dies, drawing dies, extrusion dies, punches and form rolls





Infinium T

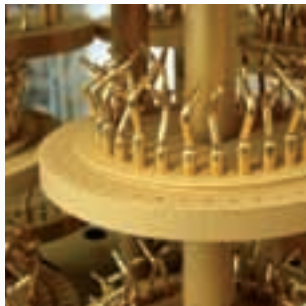
Infinium T is a Titanium Nitride (TiN) based coating. Titanium Nitride was the first commercially available hard coating on the market. It took almost a decade to gain acceptance and has proven to be useful to this day. It has a beautiful gold color and is very hard and wear resistant. Although PVD Titanium Nitride has become a commodity coating, there are still many differences in the quality of the coatings among suppliers.

Crystallume's Infinium T is optimized through a patented process to give you consistent coating properties. It is important to match these coating properties to the application and the quality required. For applications such as medical instruments or injection molds, the consistency, abrasion resistance, and quality will be most important, while for commodity drills and decorative applications the lowest price per piece may dictate the coating specifications. These differing properties can be gained through the adjustment of the temperature that the coating is applied at and the total thickness of the coating.

Infinium T Applications

Cutting Tools

- Machining of ferrous materials
- Significant tooling lifetime improvement for unalloyed and softer irons and steels (Rc<32)



Medical

- Excellent biocompatibility
- Approved for use in implants and surgical devices
- Improved wear resistance
- Easier cleaning and sterilization

Forming Tools

- Punches and dies with hard and lubricious surfaces

Molds

- Plastic injection molding – good release and abrasion resistance

General

- Reduces abrasive/adhesive wear
- Brilliant color for decorative applications

Certification Available

- AMS 2444 Class 1



Infinium Z

Infinium Z is a Zirconium Nitride (ZrN) based coating. Infinium Z is a complementary PVD coating to Infinium T. It has similar performance characteristics to Infinium T, with the exception of having a lower sticking probability when machining aluminum and aluminum alloys due to its smoother surface and better chemical resistance. Infinium Z has a brilliant light gold color.

Infinium Z Applications

Cutting Tools

- Machining applications for soft "gummy" materials that stick to tool

Forming Tools

- Forming and punching applications for soft "gummy" materials that stick to tool
- Decrease wear and sticking of plastics in molds for the injection molding industry

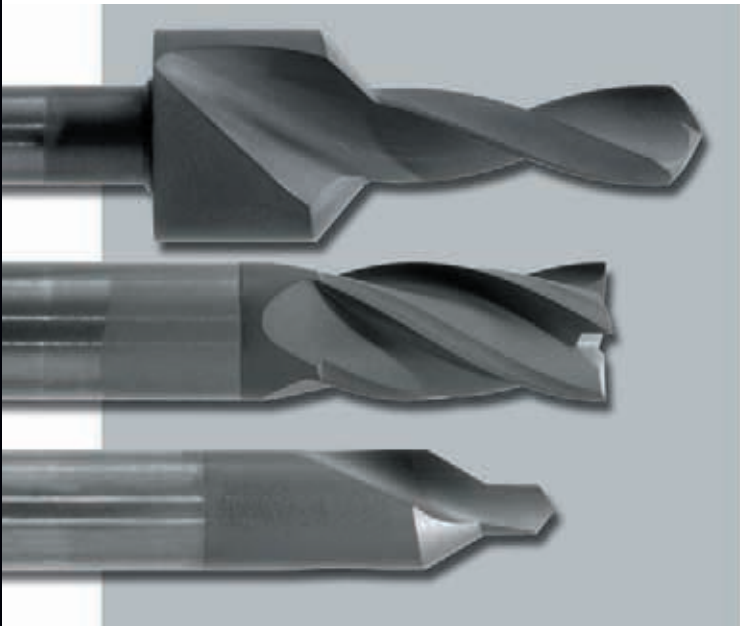
Medical

- Excellent biocompatibility
- External and internal medical devices

General

- General purpose coating
- Reduces abrasive and adhesive wear
- Brilliant color for decorative applications



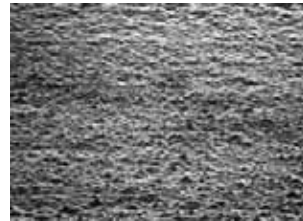


Infinium D

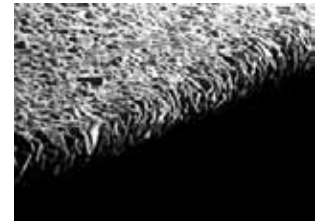
Infinium D is a diamond coating that is produced in CVD chambers built by Crystallume. Crystallume first developed the method to adhere diamond to carbide tools in a joint NCMS project that ended in 1993, and further developed the technology during a 3-year NIST funded project with Boeing, General Motors, Ford, and Hughes, which was completed in 1998. This is the product known as DCC (Diamond Coated Carbide) that has been produced for the past 20 years. At the Santa Clara, CA facility Crystallume runs 10 diamond coating systems 24/7, producing more CVD diamond than any other company in the world.

What is Diamond?

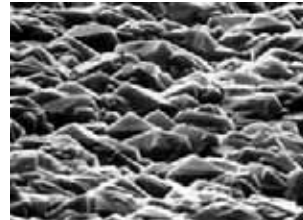
Diamond is a material with extreme properties; hardest material known, as slippery as Teflon, conducts heat four times better than copper, transparent to x-rays, excellent electrical insulator and extremely low reactivity to most chemicals. Until CVD diamond became possible, diamond was only available as individual crystals found in nature or manufactured in large heated presses. But now that diamond can be coated as a continuous film, diamond flats and shapes can be produced and three-dimensional shapes can be coated with a uniform solid film of polycrystalline diamond to give the part the benefits of diamond.



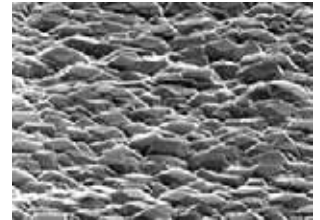
3000X smooth diamond



1000X continuous uniform coatings over the entire surface



3000X faceted diamond



3000X cubic diamond

What can be coated?

Diamond is different from the other coatings offered since it can be coated on a limited group of materials that include Tungsten Carbide (6% Cobalt only), Silicon Carbide, Silicon Nitride, and Titanium. The high temperature during diamond growth (1700°F) will damage many other materials.

What types of diamond coatings are available?

Crystallume has several different Infinium D coatings available. The standard diamond coating is 5 to 30 microns thick with an average grain size of 12 microns. Smooth diamond coating is coating 3 to 12 microns thick with an average grain size of .5 microns. The third coating, cubic diamond, has flat cubic morphology for wear surface applications.

Infinium D Applications

Cutting Tools

- Graphite
- Medium-to-high-silicon aluminum
- Carbon-fiber composites
- Wood
- Plastics
- Other non-ferrous materials

Heat Management

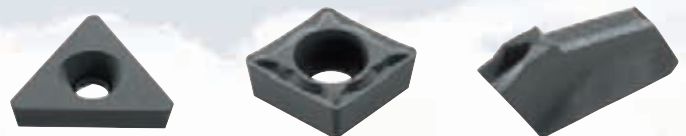
- High thermal conductivity for use as a heat spreader

Wear Surface

- Excellent wear surface material
- Chemically stable
- Bearing and seal material

Barrier Layer

- Semiconductor manufacturing
- Protects ceramic parts from chemical or plasma etching



Physical Vapor Deposition, Questions and Answers

How thick is the coating?

1-4 microns thick (25 microns = 0.001 inch)

What is the build-up?

Uniform 1-4 microns over the entire surface being coated.

Can I re-coat?

Yes, but increased film stress due to coating thickness may cause failures.

What does PVD mean?

Physical Vapor Deposition.

What is the difference between PVD and CVD (Chemical Vapor Deposition)?

CVD coatings are usually thicker and are done at higher temperatures.

How much does the coating penetrate into the surface?

Not at all.

Can you strip the coating?

Yes, some coatings and materials. Check with engineering.

Can you mask certain areas of the part?

Yes. Masking of parts can be done for additional cost.

Can you coat over black oxide?

No.

Can you coat over chrome plating?

Yes.

I already have tools coated with TiN; but now I want TiAlN. Can you simply coat over the TiN?

Yes, but there may be issues with the total coating thickness and performance will not equal coating on uncoated tools.

How do you price the coating?

Coating type, quantity, part size, and load size.

Can you double dip the tool for me?

No, coatings are optimized for the correct thickness. Too thick and the coating will fail.

What about coating inside diameters?

We can coat 1-1/2 times the diameter of the bore down into the part.

What can you coat?

Carbides, Steels (some considerations due to temperature), light alloys (engineering approval), non-ferrous heavy metals (engineering approval), electroplated parts (engineering approval), ceramics (engineering approval).

Can you coat aluminum?

Yes, but requires engineering approval.

I have a tool that I only need the tip coated so can I get a better price?

No, coating price is based on the total volume that the tool takes up.

What is the smallest tool you can coat?

Tools as small as you can make. Tools as small as 0.015 are common. Smaller tools may require special tooling.

What is your turn around time for PVD?

Typically 2-5 days.

Can you do 24 hr. or 48 hr. service? How much?

Yes, with expedite charges.

Do I have to do anything special to the parts before I send them in?

No.

Do you have quantity breaks for better pricing?

Only on inserts.

What about brazed tip tooling?

We need to know the braze temperature.

How long does the actual coating process take?

6 to 8 hours.

Can I clean the tools/parts myself and save time and money?

No, the cleaning is an important part of the coating process.

Do I need special coolants for coated tools?

No.

Can I run dry with coatings?

Speak with our Application Engineers.

Do you have a minimum order charge?

\$50.00



For more information contact:



Crystallume

ENGINEERED PVD COATINGS

3300 Nicolaus Road
Lincoln, CA 95648
Toll Free: 866 783-9700
Phone: 916 645-3560
Fax: 916 645-0146
www.crystallumepvd.com

Crystallume PVD is a division of RobbJack Corporation, manufacturer of premium rotary cutting tools and experts in application technology.

ROBB JACK
CORPORATION
Manufacturers of Premium Rotary Cutting Tools


Crystallume
Engineered Diamond Products
A Division of RobbJack Corporation

'2008 Crystallume, DCC' is a registered trademark of Crystallume.