TRD

THERMOREACTIVE DIFFUSION

Progressive Coating Technology
For Metal Forming Applications

RICHTER PRECISION INC.

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Richter Precision Inc. is North America's preeminent PVD, CVD, TD and DCD coating company. Since 1978, our coatings have been helping customers realize the full potential of their tools, thereby improving the efficiency and profitability of their manufacturing operations. Our one goal is to provide our customers with the best possible coating process and composition for their particular application.

We are pleased to provide Thermoreactive Diffusion (TD or TRD) coating processes as part of our line of wear-resistant coatings. TD coatings perfectly compliment the PVD, CVD & DCD treatments that we offer, thereby allowing us to provide the best coating process and composition for a customer's particular application. Our TD coatings will unlock the full potential of your tools.

General Comparison of Process Characteristics

Process Characteristics	PVD Physical Vapor Deposition	CVD Chemical Vapor Deposition	TD or TRD Thermoreactive Diffusion	DCD Dynamic Compound Deposition
Method	Processed in a vacuum chamber (10^{-2} to 10^{-4} mbar)	Processed in atmospheric or vacuum reactor	Processed in an elemental salt bath	Processed in a proprietary vessel
Temperature	Low process temperature (320° to 800° F)	High standard process temperature (1925°F)	High temperature process (1750° to 1900°F)	Low temperature process (100° F)
Deposition Limitations	Line of sight process	Coats wherever gases contact the tool surface	Coats wherever reactive bath contacts the substrate	Coats wherever coating media contacts the surface
Bond Type	Physical	Chemical & metallurgical	Diffusion	Mechano-chemical
Average Thickness	1-5 μm, or .00004-.0002"	4-12 μm, or .00016-.00047"	4-12 μm, or .00016-.00047"	0.5-2 μm, or .00002"-.00008"
Material Limitations	Suitable for a wide range of substrates	More limited range of substrates than for PVD	More limited range of than for PVD: less than CVD	Suitable for a wide range of substrates
Tolerances	Ideal for closely toleranced components (+/-.0001)	Requires loose tolerances (ex.: +/-.0005 per 1.0" dia.)	Similar to CVD - some materials more stable	Ideal for closely toleranced components (+/-.0001)
Post-Processing	No heat-treating required after coating	Heat-treating required on steel parts	HT required on HSS; tools steels need to be tempered	No heat-treating required after coating
Edge Build-Up	No excessive coating build-up	Requires hone on edges due to thicker coating	Requires hone on edges due to thicker coating	No excessive coating build-up
Surface Finish	Coating generally replicates existing surface finish	Post-coating polish can achieve good finishes	Post-coating polish can achieve good finishes	Coating may have slight matte effect

WHAT IS TD COATING?

Thermoreactive Diffusion (TD or TRD) is a high temperature coating process for producing metal carbides (typically vanadium carbide) on the surface of a carbon-containing substrate. This is a multi-stage coating process which utilizes a pre-heat cycle, a coating segment, ultra-sonic cleaning, heat-treating, and post-coating polishing. The coating segment is performed in a molten bath [typically consisting of a solute (Borax), a metal source, and a reducing agent]: carbide-forming compounds in the bath react with carbon in the substrate and produce metal carbides on the substrate surface. TD coatings exhibit a diffusion type bond, thereby providing superb adhesion between the metal carbide layer and the substrate. This bonding characteristic, combined with the coating's high micro-hardness, provides excellent resistance to the types of wear and galling often seen in many metal-forming processes.

When is TD Coating a better choice?

A simple truism regarding coatings is as follows: when the substrate and tolerances allow, high temperature coating processes, such as TD & CVD, are almost always the best choice. This is especially true in stamping and forming applications where the superior adhesion characteristics of high temperature coatings are better suited to the high shearing stresses.

TD coatings are commonly used for many of the same applications as CVD coatings. While the choice between these processes can often be a matter of preference rather than performance, there are two specific reasons for choosing TD over CVD:

1.Application - Due to oxidation resistance and/or a lack of chemical interaction, there are several applications where TD coatings perform better: aluminum and zinc die-casting components, hot forging tools, and tools for stamping and forming stainless steels.

2.Tool Substrate - Some materials are better suited for the TD process than for CVD. Example: S-7 tool steel has an austenizing temperature of 1750° F. CVD is processed at 1925° F (above S-7's austenizing temperature), thereby causing detrimental grain growth. Conversely, TD can be processed at 1750° F, depositing an excellent wear resistant coating without adversely affecting the tool material. The same is true for A-2 tool steel.

The following are all typical applications for the TD process:

- Extrusion Punches & Dies
- Perforating Punches
- Burring Punches
- Shaving Punches
- Embossing Rolls
- Coining Punches & Dies
- Draw Punches & Dies
- Knurling Tools
- Bending Dies
- Forming Dies
- Hot Forging Dies
- Powder Compaction Dies
- Wire Draw Plugs
- Tube Mandrels
- Die-Casting Molds & Cores

TDkote™ [VC-NbC]

TD is a great choice for heavy load applications like metal-forming, extrusion, and cold-heading. While its characteristics are similar to CVD, it is better suited when forming stainless steels and in hot forging applications.

TDkote™+S [VC-NbC/(Mo, W)S_2]

This coating provides increased performance for heavy load applications like metal-forming, extrusion, and cold-heading. The (Mo, W)S_2 dry-film lubricant layer of this coating greatly reduces the friction between tooling and work piece, reduces pick-up of material, and improves the release properties. When the tooling substrate and the tolerances allow, this coating works well in forming most materials, especially stainless steels.

TRD Coating Specifications and Technical Data

Name	Composition	Thickness (Microns)	Micro-hardness (HV)	Coefficient of Friction	Max. Working Temp.	Process Temp.
TDkote™	VC-NbC	4-12	3400-3800	0.3	700°C/1292°F	1000°C/1832°F
TDkote™+S	VC-NbC/(Mo, W)S_2	4-12	3400-3800	0.15	700°C/1292°F	1000°C/1832°F

Data generated from lab samples. Characteristics may vary depending customer's material, surface condition and part geometry. Additional coating compositions, thicknesses, and processing temperatures are available upon request.

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