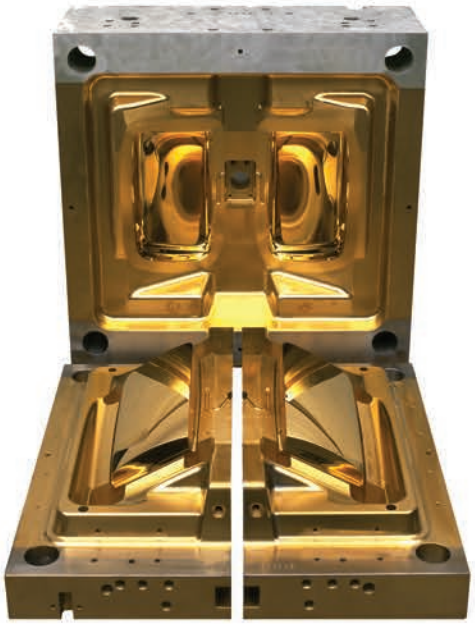
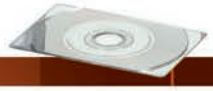




Replikote™

PVD COATING TECHNOLOGY

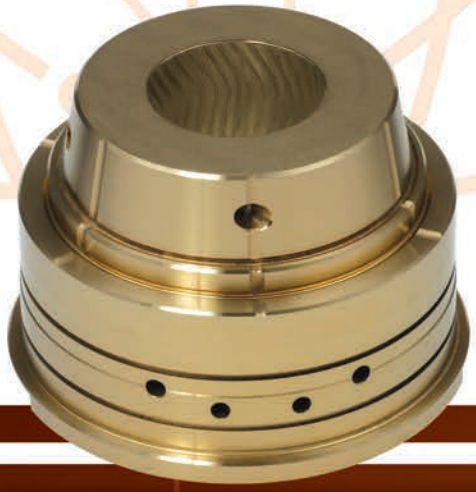
Advanced Coating Technology
for Molding Applications

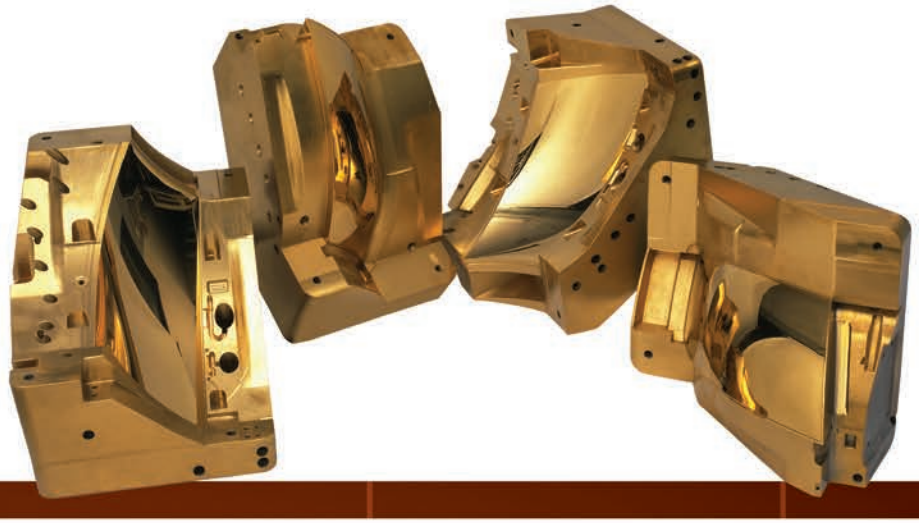
RICHTER PRECISION INC.

RICHTER PRECISION INC.

Ahead of our time, and the competition

Richter Precision Inc. is North America's North America's preeminent PVD, CVD, TD and DCD coating company. Since 1978, our focus has been on helping customers improve the efficiency and profitability of their tools and products through the deposition of advanced thin-film coatings. We have developed numerous technologies to meet a wide range of challenges. Our Replikote™ PVD coating technology, developed primarily for plastic injection molding applications, dramatically improves wear and release characteristics while maintaining critical surface finishes.





Benefits of Using Replikote™ PVD Coating

1. Defect-Free Layer – Our Replikote™ technology eliminates macro-particle inclusions within the thin-film layer. This allows us to replicate existing polished or textured surface conditions.

2. Excellent Adhesion – Unlike electrolytic plating processes, Replikote™ is not prone to the micro-fracturing that may affect their adhesion. The adhesion of our PVD coatings exceed 35 N.

3. Extremely High Hardness – The micro-hardness of these PVD coatings are far in excess of what can be achieved with tool steels, HSS, or even carbide (> 80 HRc).

4. Low Friction – The low coefficient of friction exhibited by our Replikote™ PVD coatings, ranging from 0.10 - 0.35, allow for excellent release properties, as well as improved material flow.

5. Low Surface Energy – The low surface energy of our Replikote PVD coatings, typically 3-6 mN/m, also improves part release and material flow.

6. Controlled Thickness – Replikote™ PVD coating can be controlled to within +/- .00005". Unlike other platings, PVD coats evenly, without preferential build-up on edges and corners.

7. Corrosion Protection – While Ni and Cr platings will offer better corrosion protection against water/humidity, PVD coatings offer better protection against corrosive gases, such as HF & HCl.

8. No Post-Coat Polish Required – Replikote™ PVD coatings are ready to go immediately after coating: no post-coating polishing or other processing is required.

9. Biocompatible – Replikote™ PVD coatings are inert and have passed basic biocompatibility testing, and are used regularly in food and medical applications.

10. PVD Coatings Can be De-Coated – All of our Replikote™ PVD coatings can be removed without any damage to the substrate.

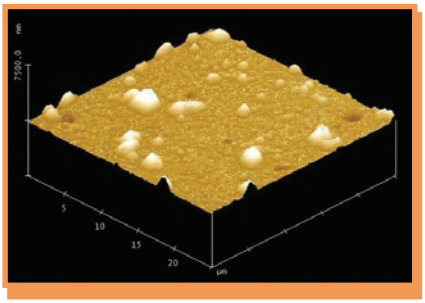
What is PVD Coating? ● ● ●

Physical Vapor Deposition (PVD) is a term used to describe a family of vacuum coating processes. The most common of these PVD coating processes are evaporation (typically using cathodic arc or electron beam sources), and sputtering (using magnetic enhanced sources or "magnetrons", cylindrical or hollow cathode sources). All parts are processed in a vacuum chamber at working pressure (typically 10^{-2} to 10^{-4} mbar) and generally involve bombardment of the substrate to be coated with energetic positively charged ions during the coating process to promote high film density. Additionally, reactive gases such as nitrogen, acetylene or oxygen may be introduced into the vacuum chamber during metal deposition to create various compound coating compositions. The result is a very strong bond between the coating and the substrate and tailored physical, structural and tribological properties of the film.

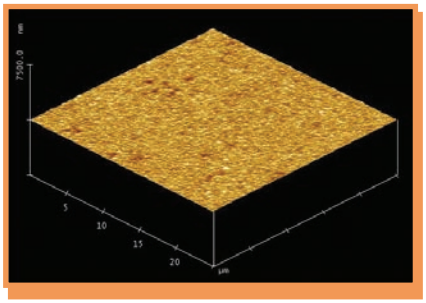
Characteristics of the PVD Coating Process ● ● ●

- Performed in a vacuum (10^{-2} – 10^{-4} mbar)
- Relatively low process temperature (320°-800°F)
- Line of sight coating deposition
- Average chamber cycle time is 4-6 hours, depending upon film characteristics & load density
- Coating exhibits a physical bond to the substrate
- Average thickness: 2-5 µm, or .00008-.0002"
- Suitable for a wide range of common mold substrates: A2, D2, H13, P20, S7, 17-4 PH SS, 420 SS 440C SS, BeCu, and more!
- Ideal for components with close tolerances (+/-.00005" is appropriate)
- No post-coating heat-treating is required
- Excellent for sharp edges: no excessive coating build-up
- PVD will replicate existing surface finishes: a high polish will be maintained

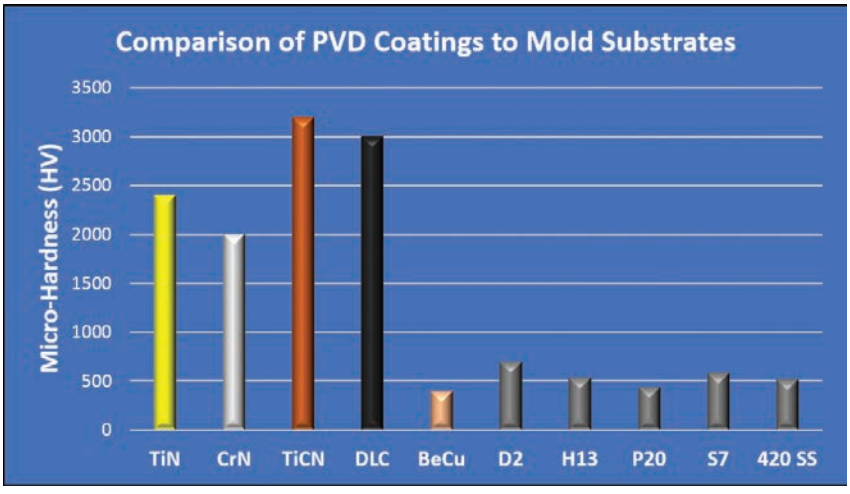
These Atomic Force Microscope (AFM) images show one of the main differences between our Replikote™ PVD coatings versus our competitors' PVD coatings. The inclusion of macro-particles in the competitor's sample (left image) creates a hazy surface condition to their PVD coatings that will transfer to the molded part. Our Replikote™ process (right image) eliminates the macro-particle inclusions. This characteristic sets our Replikote™ PVD coating apart as a superior coating process for highly polished mold components.



This 25 x 25 µm AFM image clearly shows the types of macro particles and inclusions that are created through a standard PVD TiN process. Even these small defects would transfer to the molded product, producing a hazy appearance.



This 25 x 25 µm AFM image of a Replikote™ C TiN coating is typical of this our process. The macro particles have been "filtered" to create a coating layer free of defects, making this coated surface suitable for any molding application, even optical.



This chart compares the hardness of our Replikote™ PVD coatings to some of the more common mold substrates. The hardness of these materials is shown in their typical hardness range. For example, D2 is shown at 60 HRc, which converts to 697 HV. Please note that 80 HRc is approximately 1865 HV.

Replikote™ C (TiN)

This is a fantastic general purpose coating for most plastic injection molding applications. Our Replikote™ C tends to be more than sufficient for 90% of our customers' molding applications. In addition to very good wear and release characteristics, the TiN layer provides good corrosion protection from HCl gases.

Replikote™ C3 (CrN)

Due to the chromium-based composition, our Replikote™ C3 is primarily used for rubber and die-cast (Al & Zn) molding applications. This coating is also very good at protecting mold surfaces from chemical attack, especially from hydrogen fluoride (HF) gases.

Replikote™ C5 (TiCN)

This TiN/TiCN multi-layer thin-film coating is typically used when additional abrasion resistance is required. The higher micro-hardness of this film gives enhanced wear characteristics. Replikote™ C5 is used on mold components that see higher load and wear.

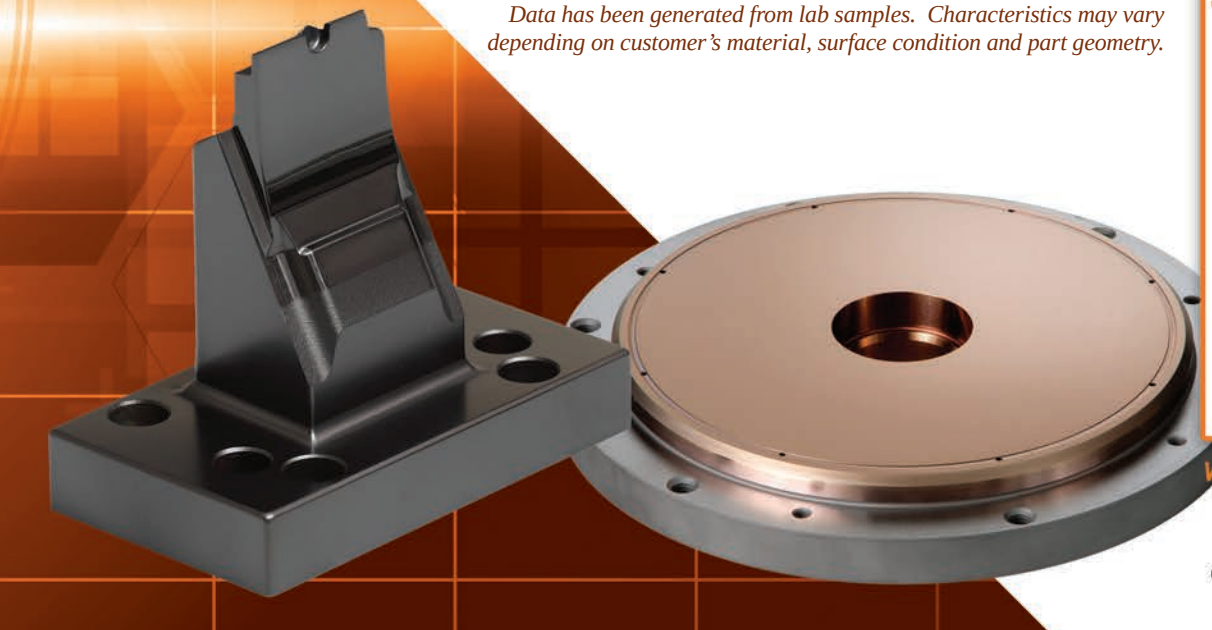
Replikote™ C11 (DLC)

Our Replikote™ C11 is the smoothest DLC coating on the market. This coating combines very good micro-hardness characteristics with a very low coefficient of friction to give excellent wear and friction protection. This coating will improve the material flow and release of mold parts, and works especially well on moving parts, such as ejector pins.

Standard Replikote™ PVD Coating Processes

Proprietary Name	Composition	Color	Thickness (microns)	Micro-Hardness	Max. Working Temp.	Process Temp.
Replikote™ C	TiN	Gold	1-5	2300-2500	600˚C / 1112˚F	375˚C / 707˚F
Replikote™ C3	CrN/CrC	Silver	1-5	2000-2200	700˚C / 1292˚F	375˚C / 707˚F
Replikote™ C5	TiCN	Bronze/ Grey	1-5	2800-3200	400˚C / 752˚F	375˚C / 707˚F
Replikote™ C11	DLC (a-C:H)	Black	1-5	2000-3000	350˚C / 662˚F	220˚C / 428˚F

Data has been generated from lab samples. Characteristics may vary depending on customer's material, surface condition and part geometry.



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