Serac C *CVD Coating*

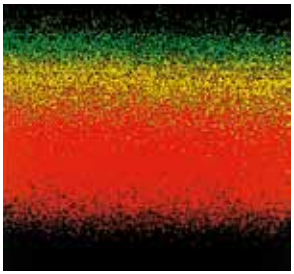
High Performance with a Well-Established Reputation

Chemical vapor deposition (CVD) supplies various high-purity raw materials in gas form to objects that have been heated to high temperature (900°C to 1050°C), causing a chemical reaction and forming an ultra-hard ceramic surface coating with adhesion in the range of 2,000 HV to 4,000 HV. The formation of a layer with outstanding wear-resistance and galling resistance substantially increase the life spans of treated parts.

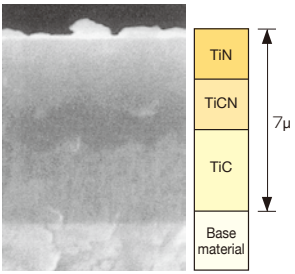
Serac C is an exceptionally high-performance CVD coating comprising a single or multiple layers of TiC, TiCN, or TiN applied with state-of-the-art low-pressure equipment. Serac C uses advanced film quality control technology, vacuum heat treatment technology, and pre-coating precision machining technology combined with comprehensive expertise.

● Punches, dies, and irregularly shaped parts

● "EPMA analysis of three-layer Serac

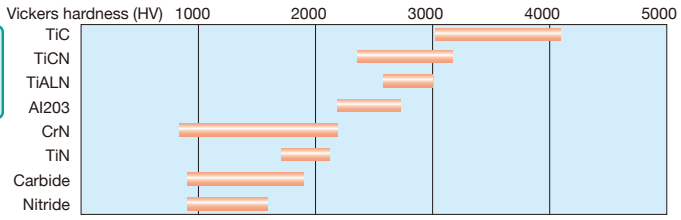


● Cross section structure of three-layer Serac



Comparison of Serac C Hardness and Physical Properties

● Comparison of the Hardness of Different Film Types



A single layer of TiC can also be applied in the same manner as multiple layers of Serac C.

Features of Serac C

1 Ultra-high wear resistance

Select ultra-hard ceramic (TiC, TiCN, or TiN) with a hardness of 2,000 HV to 4,000 HV according to the use to obtain optimal wear and galling resistance.

2 High adhesion

The standard three-layer coating comprises a base of dispersed TiC, which has the highest hardness, with a continuous TiCN-TiN coating applied to form a duplex graident coating with outstanding adhesion properties, separation resistance, and galling resistance.

3 High and uniform quality

By using a low-pressure method and high-purity gas, the coating quality has excellent uniformity, density, and cleanliness, and as a result of optimal design of the gas linear speed, coating coverage is good with a uniform coating even in fine holes.

4 Integrated production system ensures high quality

Integrated production from selection of the base material to precision machining, coatings, and vacuum heat treatment and comprehensive technologies ensure the highest levels of quality.

●Examples of Serac C Uses

Hot & cold work dies	■Punches and dies for press molding ■Piercing punches and dies ■Drawing dies ■Trimming dies, etc.	Carbide cutting tools	■Drills ■Milling cutters, etc.
		Machine component	■Rolls ■Screws ■Tablet molding components, wear-resistant components, etc.
Hot work dies	■Cast pins, core pins, etc. for die casting	Cutting blades	■Shear blades ■Slitters, etc.

●Basic Reactions of Different Coatings

Coating	Reaction Example
TiC	$TiCl_4\,(g)+CH_4\,(g) \xrightarrow[950\text{–}1050^{\circ}C]{H_2} TiC(s)+4HCl(g)$
TiN	$TiCl_4\,(g)+1/2N_2\,(g) \xrightarrow[900\text{–}1000^{\circ}C]{H_2} TiN(s)+4HCl(g)$
TiCN	$TiCl_4\,(g)+CH_4\,(g)+1/2N_2\,(g) \xrightarrow[900\text{–}1050^{\circ}C]{H_2} TiCN(s)+4HCl(g)$

Examples of the Effects of Serac C

Component	Machining details	Machined material	Die material	Comparison of effects			pcs or units
				Treatment	Results	Serac C	Results
Auto parts	Drawing die	SPHC(t2.0)	SKD11	VC	25,000	TiC-TiCN-TiN	100,000
Bolts	Trimming die	SCr440	SKH51	TiC	98,000	TiC-TiCN-TiN	210,000
Auto parts	Blanking die	APEC(t1.6)	DC53	N/A	2,000	TiC-TiCN-TiN	28,000
Household appliance parts	Deep drawing	SPC(t1.2)	DC53	TiC	150,000	TiC-TiCN-TiN	800,000

●Physical Properties of Ti-Alloy Coatings

Physical property \ Type	Carbide	Carbonitride	Nitride
	TiC	TiCN	TiN
Color	Clear gray	Bright red	Gold
Hardness (HV)	3000–4000	2600–3200	1900–2400
Melting point (°C)	3160	3050	2950
Density (g/cm3)	4.92	5.18	5.43
Coefficient of thermal expansion (200°C– 400°C)/°C	7.8×10^{-6}	8.1×10^{-6}	8.3×10^{-6}
Electrical resistant (Ω at 20°C)	85	50	22
Coefficient of elasticity (N/mm2)	43.93×10^{4}	34.53×10^{4}	25.10×10^{4}
Proper coating thickness (μm)	4–8	6–10	4–8
Trend of major properties ┌ Hardness	High — Low		
└ Chemical stability	Low — High		