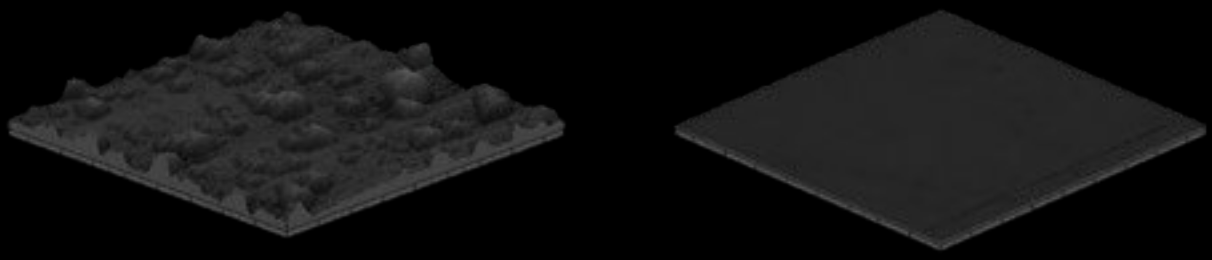
COATINGS



PLATIT® π - Series

Cathode configurations

		111 2 × LARC® PLUS, TiCN option available		411 3 × LARC®, additional options available	
	Coatings	Option	Cathodes	Option	Cathodes
1	TiN	Standard	-, Ti	ECO	Ti, -, -
				SCIL	LGD, -, -, Ti SCIL
2	TiCN	TiCN	-, Ti	ECO	Ti, -, -
3	TiAlN	Standard	Al, Ti	ECO	Al, AlTi33, Ti
				ECO	Ti, Al, -
				TURBO	Ti, Al, -, AlTi33
4	TiAlCN			ECO	Ti, Al, -
				TURBO	Ti, Al, Ti, AlTi33
5	AlTiN	Standard	Al, Ti	ECO	Al, AlTi33, Ti
				ECO	Ti, Al, -
				TURBO	Ti, Al, -, AlTi33
6	CrN	Standard	-, Cr	ECO	Cr, -, -
7	CrTiN	Standard	Cr, Ti	ECO	Ti, -, Cr
				SCIL	LGD, -, -, CrTi50 SCIL
8	ZrN	Standard	Zr, Ti	ECO	Ti, -, Zr
9	AlCrN	Standard	Al, Cr	ECO	Al, AlCr30, Cr
				ECO	-, Al, Cr
				TURBO	-, Al, Cr, AlCr30
				LACS	-, -, Cr, AlCr30 SCIL
10	AlTiCrN	Standard	AlCr30, Ti	ECO	Ti, Al, Cr
11	ALL4	Standard	Al, CrTi15	ECO	CrTi15, Al, Cr
				TURBO	Ti, Al, Cr, AlCr30
12	nACo	Standard	AlSi12, Ti	ECO	Ti, AlSi18, -
				TURBO	Ti, AlSi18, -, AlTi33
13	nACRo	Standard	AlSi12, Cr	ECO	-, AlSi18, Cr
				TURBO	-, AlSi18, Cr, AlTi33
14	TiXCo3	Standard	Al, TiSi20	ECO	Ti, Al, TiSi20
				TURBO	Ti, Al, TiSi20, AlTi33
15	TiXCo4			TURBO	Ti, Al, TiSi20, AlCr30
16	PSiX			ECO	Ti, Al, TiSi20
17	BorAC			ECO	Al, AlCrB20-10, Cr
				LACS	-, Al, Cr, TiB2 SCIL
18	BorAX			LACS	TiSi20, Al, Cr, TiB2 SCIL
19	TiB2			LACS	Ti, -, -, TiB2 SCIL
20	WC / C			SCIL	LGD, -, -, W SCIL
21	DLC1: TiCN + a-C:H:Me	TiCN	-, Ti	ECO	Ti, -, -
22	DLC1: nACRo + a-C:H:Me	TiCN	AlSi12, Cr	ECO	-, AlSi18, Cr
23	DLC2: TiN + a-C:H:Si			SCIL & DLC	LGD, -, -, Ti SCIL
24	DLC2: CrN + a-C:H:Si			DLC	-, -, Cr
25	DLC2: CrTiN + a-C:H:Si			DLC	Ti, -, Cr
26	DLC3: Cr + ta-C / a-C			LACS	-, -, Cr, C SCIL
27	nACoX			ECO & OXI	Ti, AlSi18, AlCr45
				TURBO & OXI	Ti, AlSi18, AlCr45, AlTi33

Further coatings and cathode configurations on request

711 2 × Planar HiPIMS & PECVD mode	1011 4 × Planar ARC, Plasma-Nitriding & Double-Pulsed options available		1511 3 × LARC® XL & 2 × Planar ARC
Cathodes	Option	Cathodes	Cathodes
Ti, Ti	Standard & Double-Pulsed	Ti, -, Ti, -	Ti, -, -, Ti, -
	Standard	Ti, -, Ti, -	
	Standard & Double-Pulsed	Ti, AlTi40, TiAl50, AlTi40	
	Standard	Ti, TiAl25, Ti, TiAl25	
	Standard & Double-Pulsed	Ti, AlTi40, AlTi33, AlTi40	Ti, Al, -, AlTi33, AlTi33
Cr, Cr	Standard & Double-Pulsed	Cr, -, Cr, -	
	Standard	Ti, Cr, Ti, Cr	
	Standard	Ti, Zr, Ti, Zr	
	Standard & Double-Pulsed	Cr, AlCr35, AlCr35, AlCr35	-, Al, Cr, AlCr35, AlCr35
	Standard & Double-Pulsed	Cr, AlTi40, AlCr35, AlTi40	
	Standard & Double-Pulsed	Cr, AlCr35, AlTi33, AlCr35	
	Standard & Double-Pulsed	Ti, AlTi40, AlTiSi30-10, AlTi40	Ti, Al, TiSi20, AlTi33, AlTi33
			-, AlSi18, Cr, AlCr35, AlCr35
	Standard & Double-Pulsed	Ti, AlTi40, TiSi20, AlTi40	Ti, Al, TiSi20, AlTi33, AlTi33
	Standard & Double-Pulsed	Ti, AlTi40, TiSi20, AlTi40	Ti, Al, TiSi20, TiSi20, AlTi33
	Standard	Ti, -, Ti, -	
Cr, Cr			
Cr, C			

Coatings for cutting tools

				Turning	Milling			Gear cutting			
	WORKPIECE MATERIAL			Inserts	Inserts	Shank tools	Micro tools	Hobs	Pinion cutting	Skiving	Fly cutters, stick blades
1	**Steels unalloyed < 1000 N / mm²**	Dry	A	nACo	ALL4	ALL4	AlCrN	ALL4	ALL4	ALL4	TiXCo4
			B	AlTiN	BorAC	BorAC	-	BorAC	BorAC	AlCrN	AlTiCrN
		Wet	A	nACo	AlTiCrN	AlTiCrN	AlCrN	AlTiCrN	AlTiCrN	AlTiCrN	TiXCo4
			B	AlTiN	ALL4	ALL4	-	ALL4	ALL4	ALL4	AlTiCrN
2	**Steels unalloyed > 1000 N / mm²**	Dry	A	nACo	ALL4	ALL4	AlCrN	ALL4	ALL4	ALL4	TiXCo4
			B	AlTiN	BorAC	BorAC	-	BorAC	BorAC	AlCrN	AlTiCrN
		Wet	A	nACo	AlTiCrN	AlTiCrN	AlCrN	AlTiCrN	AlTiCrN	AlTiCrN	TiXCo4
			B	AlTiN	ALL4	ALL4	-	ALL4	ALL4	ALL4	AlTiCrN
3	**Steels hardened < 55 HRC**	Dry	A	TiXCo4	TiXCo4	TiXCo4	TiXCo3	-	-	TiXCo4	-
			B	nACo	nACo	nACo	-	-	-	ALL4	-
		Wet	A	TiXCo4	TiXCo4	TiXCo4	TiXCo3	-	-	TiXCo4	-
			B	nACo	nACo	nACo	-	-	-	ALL4	-
4	**Steels hardened > 55 HRC**	Dry	A	TiXCo3	TiXCo3	TiXCo3	TiXCo3	-	-	TiXCo4	-
			B	PSiX	PSiX	PSiX	-	-	-	BorAX	-
		Wet	A	PSiX	PSiX	PSiX	TiXCo3	-	-	TiXCo4	-
			B	nACo	nACo	nACo	-	-	-	BorAX	-
5	**Stainless steel**	Dry	A	nACo	nACo	nACo	nACo	-	-	-	-
			B	AlTiN	AlTiN	AlTiN	-	-	-	-	-
		Wet	A	PSiX	PSiX	PSiX	nACo	-	-	-	-
			B	AlTiN	AlTiN	AlTiN	-	-	-	-	-
6	**Stainless steel > 45 HRC**	Dry	A	TiXCo3	TiXCo3	TiXCo3	TiXCo3	-	-	-	-
			B	nACo	PSiX	PSiX	-	-	-	-	-
		Wet	A	TiXCo3	TiXCo3	TiXCo3	TiXCo3	-	-	-	-
			B	TiAlCN	PSiX	PSiX	-	-	-	-	-
7	**Superalloys Ni-based**	Dry	A	nACoX	nACoX	BorAX	TiXCo3	-	-	-	-
			B	AlTiN	ALL4	ALL4	-	-	-	-	-
		Wet	A	nACoX	nACoX	BorAX	TiXCo3	-	-	-	-
			B	AlTiN	ALL4	ALL4	-	-	-	-	-
8	**Superalloys Ti-based**	Dry	A	nACo	nACo	nACo	nACo	-	-	-	-
			B	-	nACRo	nACRo	nACRo	-	-	-	-
		Wet	A	nACo	nACo	nACo	nACo	-	-	-	-
			B	-	nACRo	nACRo	nACRo	-	-	-	-
9	**Cast iron**	Dry	A	nACo	nACo	nACo	nACo	-	-	-	-
			B	AlTiN	AlTiN	AlTiN		-	-	-	-
		Wet	A	nACo	nACo	nACo	nACo	-	-	-	-
			B	AlTiN	AlTiN	AlTiN		-	-	-	-
10	**Aluminium Si > 12 %**	Dry	A	nACRo	nACRo	nACRo	nACRo	-	-	-	-
			B	TiB2	TiB2	TiB2	TiB2	-	-	-	-
		Wet	A	nACRo	nACRo	nACRo	nACRo	-	-	-	-
			B	TiB2	TiB2	TiB2	TiB2	-	-	-	-

A primary recommendation
B secondary recommendation

	Sawing		Drilling		Deep hole drilling	Reaming	Broaching	Tapping	
	Saw blades	Band saws	Drilling	Micro tools				Taps, thread cutters	Tap forming, thread forming
	AlTiCrN AlTiN	nACo TiAlCN	AlTiN TiXCo3	AlTiN TiXCo3	AlTiN TiXCo3	nACo TiXCo3	TiN TiCN	TiN TiCN	TiCN CrTiN
	AlTiCrN AlTiN	nACo TiAlCN	AlTiN TiXCo3	AlTiN TiXCo3	AlTiN TiXCo3	nACo TiXCo3	TiN TiCN	TiN TiCN	TiCN CrTiN
	AlTiCrN AlTiN	nACo TiAlCN	AlTiN TiXCo3	AlTiN TiXCo3	AlTiN TiXCo3	nACo TiXCo3	AlTiN TiCN	TiN TiCN	TiCN CrTiN
	AlTiCrN AlTiN	nACo TiAlCN	AlTiN TiXCo3	AlTiN TiXCo3	AlTiN TiXCo3	nACo TiXCo3	AlTiN TiCN	TiN TiCN	TiCN CrTiN
	nACo AlTiN	nACo AlTiN	TiXCo3 nACo	TiXCo3 nACo	- -	nACo TiXCo3	- -	- -	- -
	nACo AlTiN	nACo AlTiN	TiXCo3 nACo	TiXCo3 nACo	- -	nACo TiXCo3	- -	- -	- -
	- -	- -	TiXCo3 -	TiXCo3 -	- -	- -	- -	- -	- -
	- -	- -	- -	- -	- -	- -	- -	- -	- -
	AlTiN TiAlCN	nACo TiAlCN	AlTiN TiXCo3	AlTiN TiXCo3	AlTiN TiXCo3	nACo TiXCo3	- -	TiN TiCN	TiCN CrTiN
	AlTiN TiAlCN	nACo TiAlCN	AlTiN TiXCo3	AlTiN TiXCo3	AlTiN TiXCo3	nACo TiXCo3	- -	TiN TiCN	TiCN CrTiN
	- -	- -	AlTiN TiXCo3	AlTiN TiXCo3	AlTiN TiXCo3	nACo TiXCo3	- -	TiN TiCN	- -
	- -	- -	AlTiN TiXCo3	AlTiN TiXCo3	AlTiN TiXCo3	nACo TiXCo3	- -	TiN TiCN	- -
	AlTiCrN AlTiN	AlTiCrN AlTiN	TiXCo4 nACoX	- -	- -	- -	- -	TiCN TiAlCN	- -
	AlTiCrN AlTiN	AlTiCrN AlTiN	TiXCo4 nACoX	- -	- -	- -	- -	TiCN TiAlCN	- -
	AlTiCrN AlTiN	AlTiCrN AlTiN	TiXCo3 AlTiN	- -	- -	- -	- -	TiCN TiAlCN	- -
	AlTiCrN AlTiN	AlTiCrN AlTiN	TiXCo3 AlTiN	- -	- -	- -	- -	TiCN TiAlCN	- -
	- -	- -	TiXCo3 nACo	- -	- -	TiXCo3 nACo	- -	TiCN TiAlCN	- -
	- -	- -	TiXCo3 nACo	- -	TiN TiCN	TiXCo3 nACo	- -	TiCN TiAlCN	- -
	nACRo ALL4	nACRo ALL4	nACRo TiB2	nACRo TiB2	- -	- -	- -	TiCN TiAlCN	- -
	nACRo ALL4	nACRo ALL4	nACRo TiB2	nACRo TiB2	- -	- -	- -	TiCN TiAlCN	- -

Coatings for cutting tools

				Turning	Milling			Gear cutting	
	WORKPIECE MATERIAL			Inserts	Inserts	Shank tools	Micro tools	Hobs	
11	**Aluminium Si < 12 %**	Dry	A	DLC3	DLC3	DLC3	DLC3	-	
			B	TiB2	TiB2	TiB2	TiB2	-	
		Wet	A	DLC3	DLC3	DLC3	DLC	-	
			B	TiB2	TiB2	TiB2	TiB2	-	
12	**Copper**	Dry	A	CrN	CrN	CrN	CrN	-	
			B	DLC2	DLC2	DLC2	DLC2	-	
		Wet	A	CrN	CrN	CrN	CrN	-	
			B	DLC2	DLC2	DLC2	DLC2	-	
13	**Bronze, brass**	Dry	A	CrN	CrN	CrN	CrN	-	
			B	DLC2	DLC2	DLC2	DLC2	-	
		Wet	A	CrN	CrN	CrN	CrN	-	
			B	DLC2	DLC2	DLC2	DLC2	-	
14	**Plastic**	Dry	A	-	-	DLC3	-	-	
			B	-	-	TiB2	-	-	
		Wet	A	-	-	DLC3	-	-	
			B	-	-	TiB2	-	-	
15	**Graphite**	Dry	A	DLC3	DLC3	DLC3	DLC3	-	
			B	-	-	-	-	-	
		Wet	A	TiXCo4	TiXCo4	TiXCo4	TiXCo3	-	
			B	DLC3	DLC3	DLC3	DLC3	-	
16	**Carbon fiber reinforced polymer**	Dry	A	-	-	DLC3	DLC3	-	
			B	-	-	TiXCo4	TiXCo3	-	
		Wet	A	-	-	DLC3	DLC3	-	
			B	-	-	TiXCo4	TiXCo3	-	
17	**Wood**	Dry	A	-	DLC2	DLC2	-	-	
			B	-	CrN	CrN	-	-	
		Wet	A	-	DLC2	DLC2	-	-	
			B	-	CrN	CrN	-	-	

A primary recommendation
B secondary recommendation

	Sawing		Drilling		Deep hole drilling	Reaming	Broaching	Tapping	
	Saw blades	Band saws	Drilling	Micro tools				Taps, thread cutters	Tap forming, thread forming
	DLC3 ZrN	ZrN -	TiB2 ZrN	TiB2 ZrN	- -	- -	- -	TiCN TiB2	TiN ZrN
	DLC3 ZrN	ZrN -	TiB2 ZrN	TiB2 ZrN	- -	- -	- -	TiCN TiB2	TiN ZrN
	CrN -	CrN -	TiAlCN CrN	- -	- -	TiXCo3 nACo	- -	TiCN TiAlCN	TiN ZrN
	CrN -	CrN -	TiAlCN CrN	- -	- -	TiXCo3 nACo	- -	TiCN TiAlCN	TiN ZrN
	CrN -	CrN -	TiAlCN CrN	- -	- -	TiXCo3 nACo	- -	TiCN TiAlCN	TiN ZrN
	CrN -	CrN -	TiAlCN CrN	- -	- -	TiXCo3 nACo	- -	TiCN TiAlCN	TiN ZrN
	- -	- -	TiXCo3 DLC2	- -	- -	- -	- -	- -	- -
	- -	- -	- -	- -	- -	- -	- -	- -	- -
	- -	- -	DLC3 BorAX	DLC3 BorAX	- -	- -	- -	- -	- -
	- -	- -	BorAX DLC3	BorAX DLC3	- -	- -	- -	- -	- -
	DLC3 -	- -	DLC3 TiXCo3	DLC3 TiXCo3	- -	- -	- -	- -	- -
	DLC3 -	- -	TiXCo3 DLC3	TiXCo3 DLC3	- -	- -	- -	- -	- -
	DLC2 CrN	- -	DLC2 TiXCo3	- -	- -	- -	- -	- -	- -
	DLC2 CrN	- -	- -	- -	- -	- -	- -	- -	- -

Coatings for chipless forming

TOOL MATERIAL		Fine blanking	Punching	Injection molding Plastic	Injection molding Aluminum	Forming, embossing	Deep drawing	Extrusion
HSS	A	AlCrN	AlCrN	-	-	CrN	ALL4	ALL4
	B	BorAC	ALL4	-	-	-	AlCrN	AlCrN
Carbide	A	AlCrN	AlCrN	-	-	-	-	-
	B	BorAC	ALL4	-	-	-	-	-
Steels unalloyed	A	-	-	CrN	AlTiCrN	-	-	-
< 1000 N / mm²	B	-	-	TiN	nACRo	-	-	-
Steels unalloyed	A	-	-	CrN	AlTiCrN	-	-	-
> 1000 N / mm²	B	-	-	TiN	nACRo	-	-	-
Steels hardened	A	AlCrN	AlCrN	CrN	AlTiCrN	CrN	ALL4	ALL4
< 55 HRC	B	BorAC	ALL4	TiN	nACRo	-	AlCrN	AlCrN
Steels hardened	A	AlCrN	AlCrN	CrN	AlTiCrN	CrN	ALL4	ALL4
> 55 HRC	B	BorAC	ALL4	TiN	nACRo	-	AlCrN	AlCrN
Aluminum Si	A	-	-	CrN	-	CrN	-	-
> 12 %	B	-	-	TiN	-	TiN	-	-
Aluminum Si	A	-	-	-	-	CrN	-	-
< 12 %	B	-	-	-	-	TiN	-	-
Copper	A	-	-	-	-	CrN	-	-
	B	-	-	-	-	TiN	-	-
Bronze, brass	A	-	-	-	-	CrN	-	-

A primary recommendation
B secondary recommendation

Coatings for components

WORKPIECE MATERIAL		Machine parts[1]	Medical components[2]			Tribology	Decorative materials
			Medical implants	Surgical, dental instruments	Anti-bacterial medical components		
Steels unalloyed < 1000 N / mm²	A	-	-	-	-	DLC2	-
	B	-	-	-	-	DLC3	-
Steels unalloyed > 1000 N / mm²	A	-	-	-	-	DLC2	-
	B	-	-	-	-	DLC3	-
Steels hardened < 55 HRC	A	CrTiN	-	-	-	DLC2	-
	B	-	-	-	-	DLC3	-
Steels hardened > 55 HRC	A	CrTiN	-	-	-	DLC2	-
	B	-	-	-	-	DLC3	-
Stainless steel	A	-	-	DLC2	ZrN	DLC2	Custom
	B	-	-	DLC3	Cr2N	DLC3	-
Stainless steel > 45 HRC	A	-	-	-	-	DLC2	Custom
	B	-	-	-	-	DLC3	-
Superalloys Ni-based	A	-	-	-	-	DLC2	-
Superalloys Ti-based	A	-	Ti2N	DLC3	-	DLC2	-
	B	-	ZrN	DLC2	-	-	-
Cast iron	A	CrN	-	-	-	-	-
Aluminum Si < 12 %	A	CrN	-	-	-	-	-
Copper	A	-	-	-	ZrN	-	Custom
	B	-	-	-	Cr2N	-	-
Bronze, brass	A	-	-	-	ZrN	-	Custom
	B	-	-	-	Cr2N	-	-
Plastic	A	-	-	-	ZrN	-	Cr2N
	B	-	-	-	Cr2N	-	Custom

A primary recommendation
B secondary recommendation

[1] in abrasive and corrosive environment such as gears, water pumps, tool holders
[2] following PLATIT coatings are tested for biocompatibility and certified accordingly: AlTiN, CrN, DLC, TiCN, TiN, ZrN

Coating properties

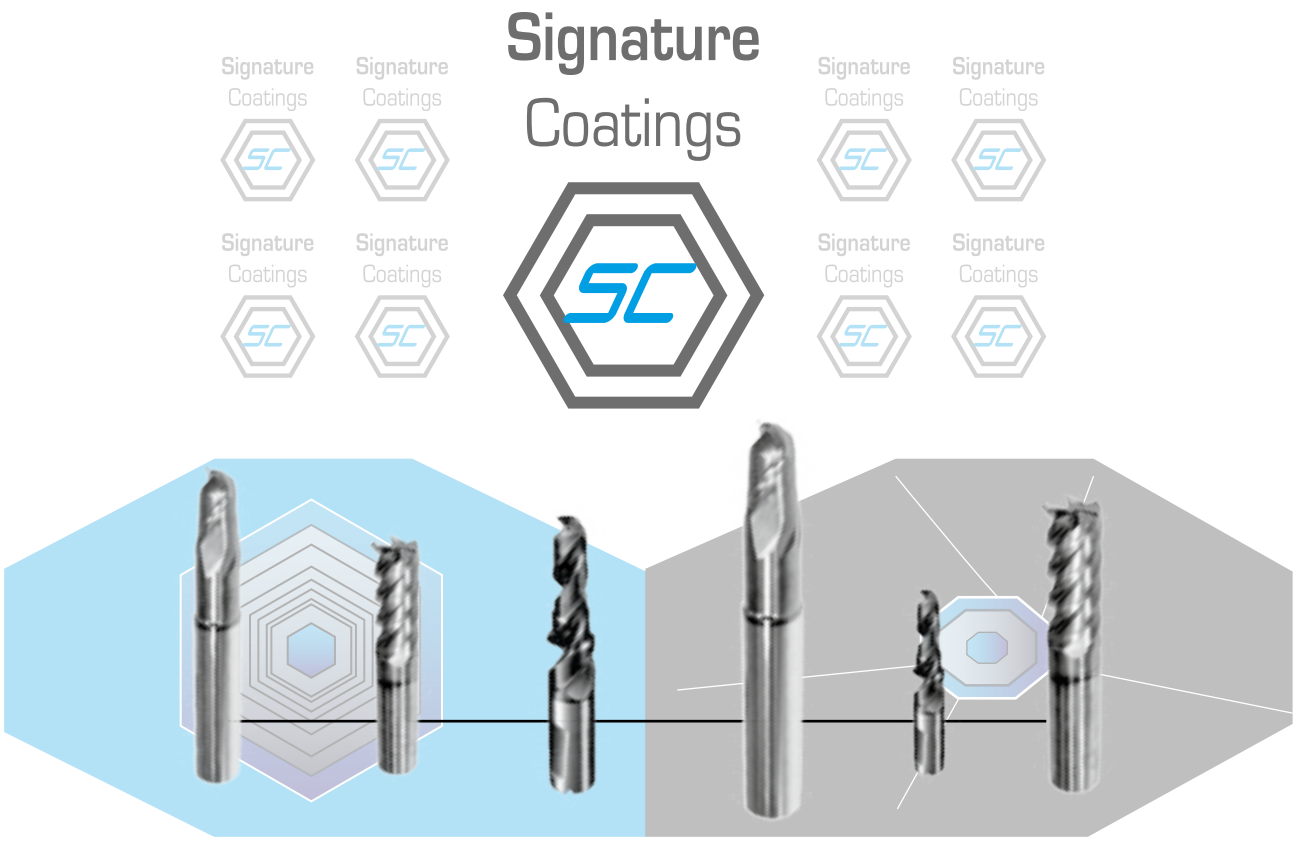
		Color	Nano-hardness [GPa] by Fisher Nanoindentor	Coating thickness [µm]	Coefficient of friction [µ] PoD (at RT, 50 % humidity)	Max. service temperature [°C]
1	**TiN**	Gold	24–26	1–10	0.4	600
2	**TiCN**	Grey	36–38	1–3	0.25	450
3	**TiAlN**	Violet grey	36–38	1–5	0.5	700
4	**TiAlCN**	Red violet	34–36	1–5	0.25	450
5	**AlTiN**	Blue grey	36–38	1–5	0.6	900
6	**CrN**	Silver	21–23	1–10	0.5	700
7	**CrTiN**	Satin silver	28–30	1–10	0.4	700
8	**ZrN**	White gold	21–23	1–5	0.4	550
9	**AlCrN**	Grey	36–38	1–5	0.5	900
10	**AlTiCrN**	Grey	36–38	1–5	0.5	900
11	**ALL4**	Grey	36–38	1–5	0.5	900
12	**nACo**	Blue violet	39–41	1–4	0.4	1200
13	**nACRo**	Grey	39–41	1–4	0.5	1100
14	**TiXCo3**	Copper	42–44	1–4	0.4	900
15	**TiXCo4**	Grey	42–44	1–4	0.4	900
16	**PSiX**	Red brown	42–44	1–4	0.4	900
17	**BorAC**	Grey	38–40	1–5	0.5	900
18	**BorAX**	Copper	42–44	1–4	0.4	1100
19	**TiB2**	Satin silver	32/38	1–5	0.4	600
20	**WC/C**	Dark grey	15–18	1–3	0.1–0.2	300
21	**DLC1: TiCN + a-C:H:Me**	Anthracite	36/20	1–3	0.1–0.2	400
22	**DLC1: nACRo + a-C:H:Me**	Anthracite	39/20	1–3	0.1–0.2	400
23	**DLC2: TiN + a-C:H:Si**	Anthracite	> 25	1–3	0.1–0.2	400
24	**DLC2: CrN + a-C:H:Si**	Anthracite	> 25	1–3	0.1–0.2	400
25	**DLC2: CrTiN + a-C:H:Si**	Anthracite	> 25	1–3	0.1–0.2	400
26a	**DLC3: Cr + ta-C / a-C in Pi411**	From rainbow colors to anthracite	45–50	0.3–1	0.1	450
26b	**DLC3: Cr + ta-C / a-C in PL711**	Anthracite	> 30	0.3–1	0.1	450
27	**nACoX**	Dark grey	30–32	4–10	0.5	1200

The given physical values may vary for different coating structures (mono-, gradient-, multi- and nanolayers).

Signature Coatings

PLATIT's Signature Coatings are exclusively developed by our R&D teams using the unique features of the PLATIT technology. They combine years of experience and know-how in the field of coating development with the latest technical innovations.

Our Signature Coatings promise the highest performance for their dedicated applications in the field of cutting, forming and tribological components. PLATIT customers can differentiate themselves from competitors and stand out from the market standard with the deposition of Signature Coatings.



PLATIT®

Signature Coating nACo

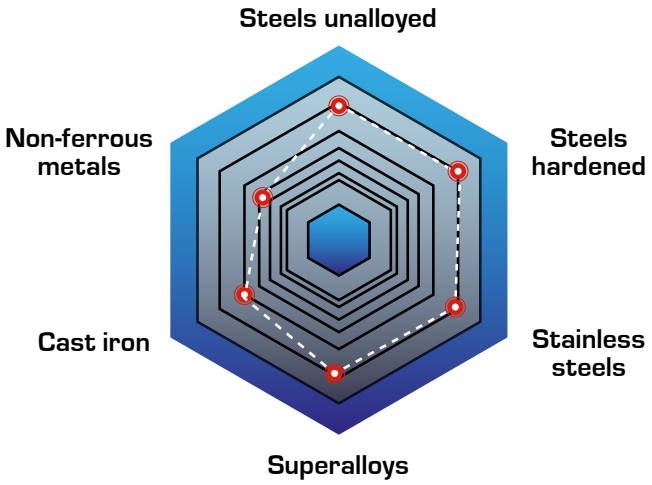
Universal nanocomposite for milling and drilling C-steels

nACo is one of PLATIT's best-known coating brands. It has proven itself on the market for over 20 years. nACo is an AlTiSi-based nanocomposite coating and performs best in the field of milling and drilling C-steels. The use of nACo provides excellent adhesion and good performance even for more unusual applications such as milling with coated ceramic tools and CBN tools.

Highlights:

- Nanocomposite with Si content
- High temperature stability
- Good hardness
- Reduces adhesion between cutting-edges and workpiece
- Versatile application possibilities

Characteristics in cutting:

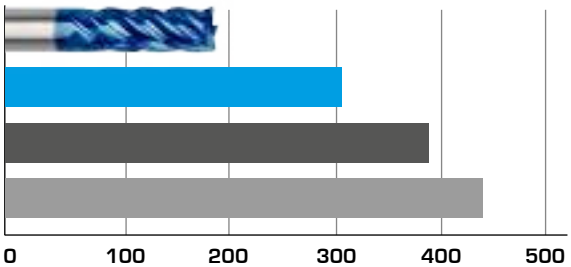


Specifications

Color	blue violet
Nano-hardness [GPa]	39–41
Coefficient of friction [µ] PoD (at RT, 50 % humidity)	0.4
Coating thickness [µm]	1–4
Max. service temperature [°C]	1200
Coating temperature [°C]	400–500
111 PLUS G3	(AlSi12, Ti)
411 PLUS ECO	(Ti, AlSi18, -)
411 PLUS TURBO	(Ti, AlSi18, -, AlTi33)
1011 G4	(Ti, AlTi40, AlTiSi30-10, AlTi40)
1511	(Ti, Al, TiSi20, AlTi33, AlTi33)

Milling in SUS316 with solid carbide end mill D4:

Wear Vb [µm] after 480 milling operations



Tool: solid carbide end mill; D4; z = 4; cutting length = 6 mm
Workpiece material: SUS316
Cooling with emulsion; ap = 0.1 mm; ae = 4 mm; vc = 100 m / min; n = 8000 rpm
fz = 0.0625 mm/z; f = 0.2500 mm/rot; vf = 2000 mm / min
Source: Tool manufacturer

Calo 3 layers

AlTi(Si)N is deposited on a TiN adhesion layer

Signature Coating TiXCo

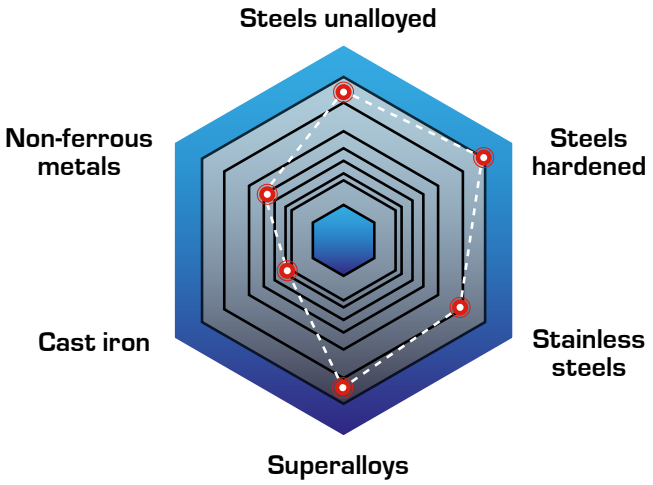
TiXCo3 and TiXCo4

As our hardest nanocomposite, TiXCo3 is especially suitable for hard machining. It can be used at very high temperatures and is therefore suitable for finishing processes in milling and drilling. TiXCo3 also provides excellent performance for finishing turbine parts. TiXCo4 is used for broadband applications.

Highlights:

- TiXCo3:
  - High surface quality
  - Extremely hard and very wear-resistant
  - For super-hard machining
- TiXCo4:
  - Wide range of application and use

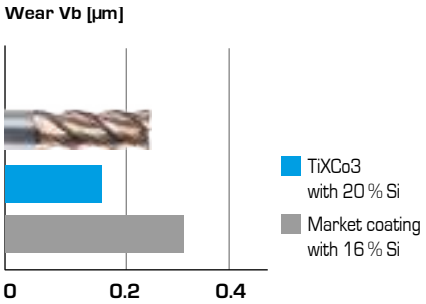
Characteristics in cutting:



Specifications

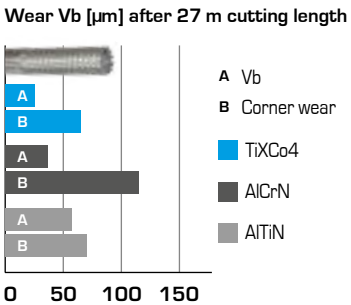
Color	copper with TiXCo3 grey with TiXCo4
Nano-hardness [GPa]	42–44
Coefficient of friction [µ] PoD (at RT, 50 % humidity)	0.4
Coating thickness [µm]	1–4
Max. service temperature [°C]	900
Coating temperature [°C]	450–500
111 PLUS G3	TiXCo3 (Al, TiSi20)
411 PLUS ECO	TiXCo3 (Ti, Al, TiSi20)
411 PLUS TURBO	TiXCo3 (Ti, Al, TiSi20, AlTi33) TiXCo4 (Ti, Al, TiSi20, AlCr30)
1011 G4	TiXCo3 (Ti, AlTi40, TiSi20, AlTi40)
1511	TiXCo3 (Ti, Al, TiSi20, AlTi33, AlTi33)

Milling in X210Cr13 with solid carbide end mill D6:

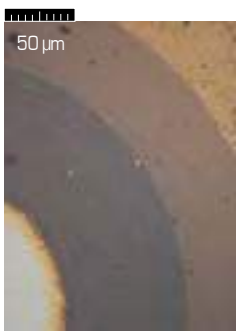


Tool: solid carbide end mill; D6
Workpiece material: X210Cr13; 1.2080; 64 HRC
Cooling: dry air, 5 bar; ap = 0.09 mm; ae = 0.06 mm;
n = 16 820 rpm; f = 0.1 mm / rot
Source: South Korean tool manufacturer

Milling in SKD61 with solid carbide end mill D8:



Tool: solid carbide end mill; D8; cutting length = 27 m
Workpiece material: SKD61; 54 HRC
Cooling with emulsion; ap = 4 mm;
ae = 0.03 mm; vc= 100 m / min
Source: Chinese tool manufacturer



Calo 3 layers

TiXCo3: TiN → AlTi(Si)N → TiSiN
TiXCo4: TiN → AlCrTi(Si)N → TiSiN

Signature Coating ALL4

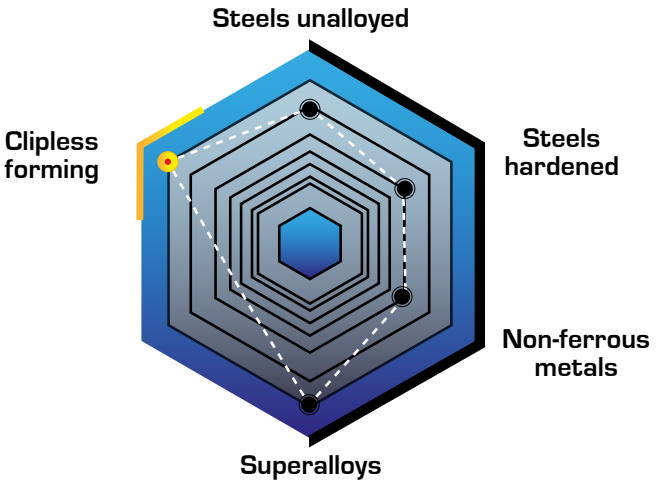
Generic coating for cutting and forming

ALL4 is an AlCrTiN universal coating. It covers a wide range of applications as well as workpiece materials. The coating is particularly suitable for materials that are difficult to machine.

Highlights:

- Covers many application processes in cutting and forming
- Suitable for different workpiece materials
- Very wear-resistant at high temperatures
- Heat-resistant and tough

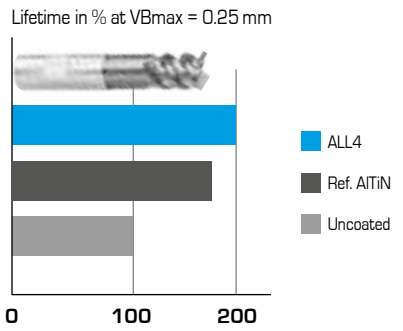
Characteristics in cutting + chipless forming:



Specifications

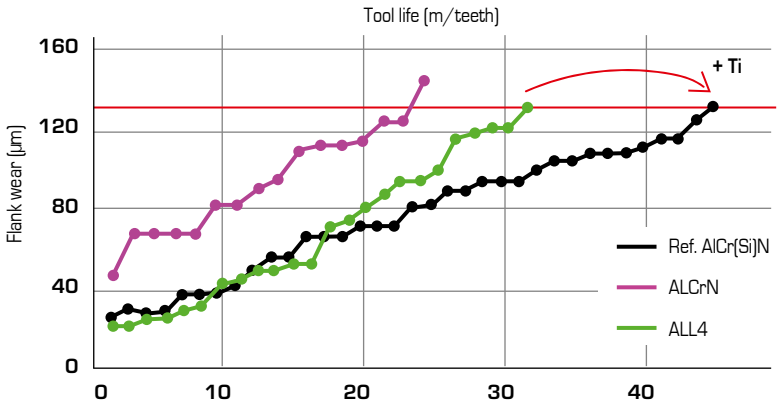
Color	grey
Nano-hardness [GPa]	36–38
Coefficient of friction [µ] PoD (at RT, 50 % humidity)	0.5
Coating thickness [µm]	1–5
Max. service temperature [°C]	900
Coating temperature [°C]	400–500
111 PLUS G3	(Al, CrTi15)
411 PLUS ECO	(CrTi15, Al, Cr)
411 PLUS TURBO	(Ti, Al, Cr, AlCr30)
1011 G4	(Cr, AlCr35, AlTi33, AlCr35)

Milling in Inconel 718:



Tool: roughing cutter; D10 × 22 / R1
Workpiece material: Inconel 718 (200 mm × 200 mm × 36 mm)
KSS: B-Cool 9665; ap = 12 mm (2×); ae = 0.1 mm; vc = 90 m / min; fz = 0.21 mm
Post-treatment: drag grinding / wet blasting
Source: GFE, Germany

Flank wear with HSS hob in 20 MnCr 5:



Tool: HSS hob; D90
Workpiece material: 20 MnCr 5
Coolant air; mn = 2.3 mm; vc = 150 m/min; fa = 1.69 mm/rot; zo = 5
Max. chip thickness hcu = 0.347 mm
Source: IFQ Magdeburg

Signature Coating TiB2

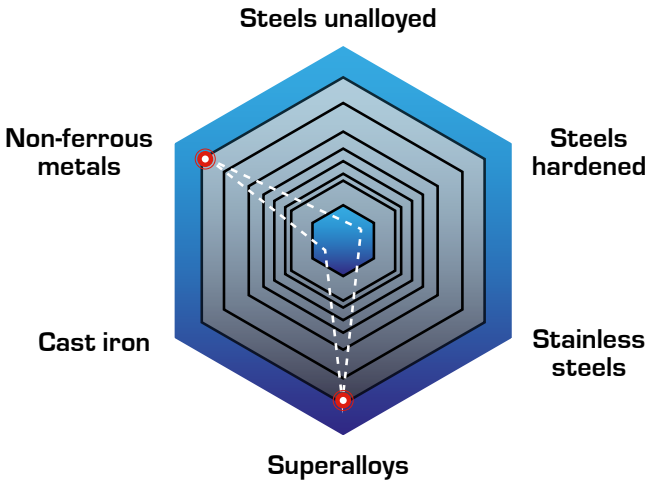
SPUTTER coating for aluminum machining

TiB2 is one of the most efficient PLATIT SPUTTER coatings. With a SCIL® configuration (SPUTTERED Coating Induced by Lateral Glow Discharge) nano-hardness of 32 GPa is achieved, which can be increased to 38 GPa with a hybrid LACS® configuration (LAteral ARC with central SPUTTERING). That means Ti alloys can be machined as well.

Highlights:

- Universal applications in aluminum
- Available in two versions: SPUTTERED SCIL® or hybrid LACS® coating
- Reduces adhesion between cutting-edges and workpiece
- Increased wear-resistance

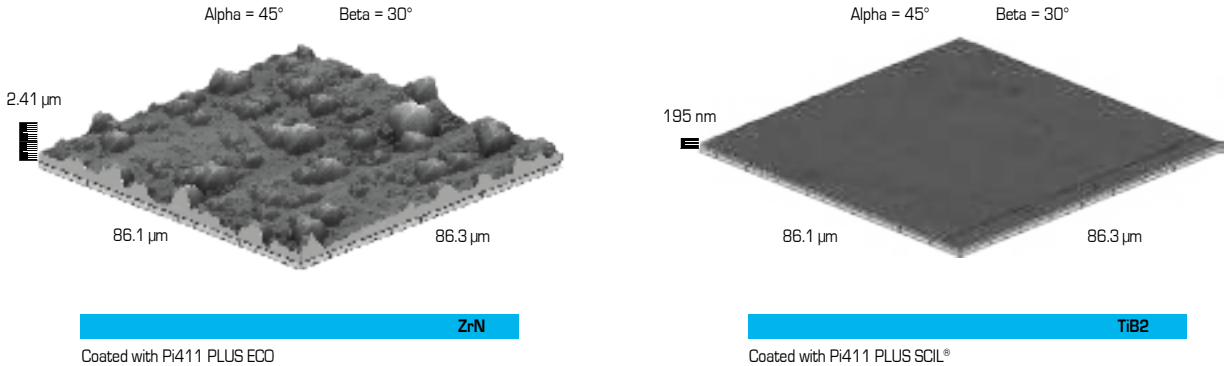
Characteristics in cutting:



Specifications

Color	satin silver
Nano-hardness [GPa]	32 / 38
Coefficient of friction [µ] PoD (at RT, 50 % humidity)	0.4
Coating thickness [µm]	1–5
Max. service temperature [°C]	600
Coating temperature [°C]	200–400
411 PLUS SCIL®	(LGD, -, -, TiB2 SCIL)
411 PLUS LACS®	(Ti, -, -, TiB2 SCIL)

Comparison of the roughness of coatings for aluminum machining:



Measured with AFM on a carbide test piece, same scale

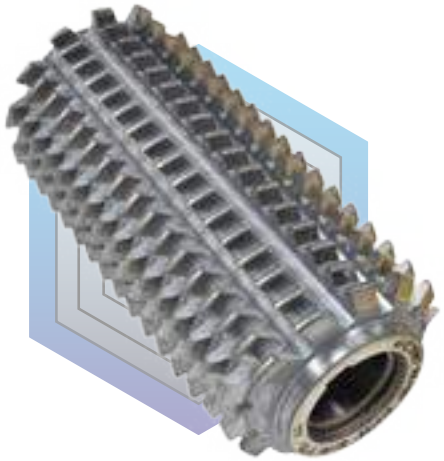
Signature Coating BorAC

Specialist for highly demanding machining

BorAC is PLATIT's selected hybrid LACS® coating with simultaneous ARC and SPUTTER processes. BorAC consists of a boron-doped AlCrN protective coating, which is especially suitable for crack inhibition and thus for high-speed applications such as transmission and gear cutting tools. BorAC delivers top performance under high loads, especially in gear hobbing and roughing (dry and wet).

Highlights:

- Low coating residual stress
- Crack-resistant
- Minimizes crater wear

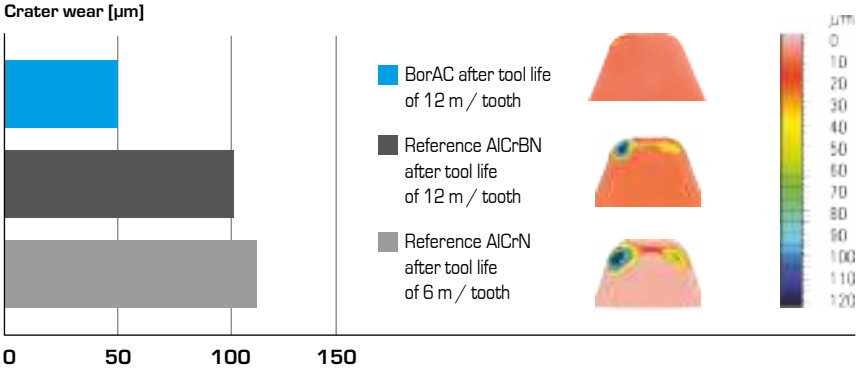


Example: HSS hobs

Specifications

Color	grey
Nano-hardness [GPa]	38–40
Coefficient of friction [µ] PoD (at RT, 50 % humidity)	0.5
Coating thickness [µm]	1–5
Max. service temperature [°C]	900
Coating temperature [°C]	400–500
411 PLUS ECO	(Al, AlCrB20-10, Cr)
411 PLUS LACS®	(-, Al, Cr, TiB2 SCIL)

Effect of boron doping on crater wear in hobs:



Tool: HSS hob; D100
Workpiece material: 20 MnCr 5
Cooling air; mn = 4 mm; vc = 220 m / min, fa = - 6.4 mm / rot
Max. chip thickness hcu = 0.24 mm
Source: IFQ Magdeburg

Calo 3 layers

CrN adhesion layer → AlCrN → AlCrBN

Signature Coating PSiX

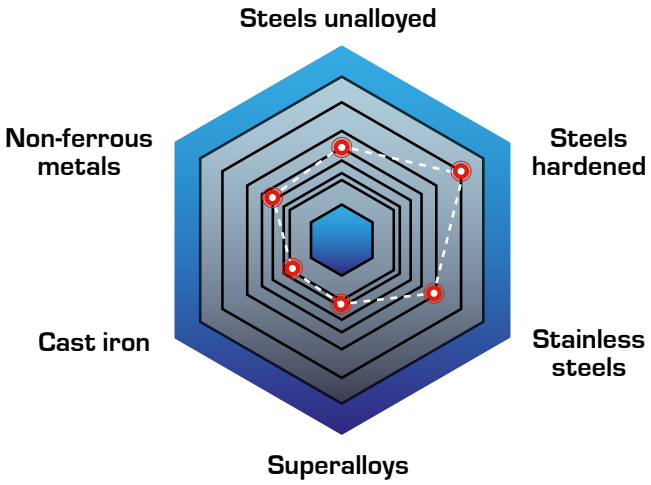
Universal hard machining coating

PSiX is a new PLATIT nanocomposite coating with a super-hard top layer. PSiX is based on TiXCo3 but has a silicon-free AlTiN base. Therefore, the aluminum content of PSiX is higher, which increases the coating's thermal stability. The coating is temperature-optimized and therefore excellent for hard machining processes like finishing and roughing.

Highlights:

- Thermal stability
- Optimized service temperature
- Low coating residual stress

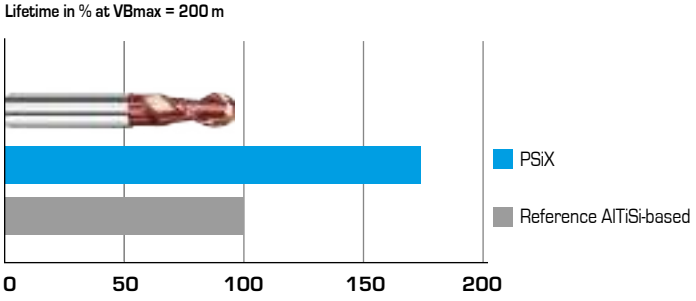
Characteristics in cutting:



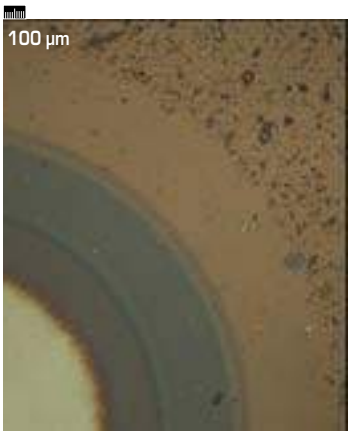
Specifications

Color	red brown
Nano-hardness [GPa]	42–44
Coefficient of friction [µ] PoD (at RT, 50 % humidity)	0.4
Coating thickness [µm]	1–4
Max. service temperature [°C]	900
Coating temperature [°C]	450–500
411 PLUS ECO	(Ti, Al, TiSi20)
1011 G4	(Ti, AlTi40, TiSi20, AlTi40)
1511	(Ti, Al, TiSi20, TiSi20, AlTi33)

Ball nose end mill in 61 HRC:



Tool: ball nose end mill; D10
Workpiece material: 1.2379; 61 HRC
ap = 0.2 mm; ae = 0.5 mm; vc = 182 m / min; fz = 0.14 mm
Source: GFE, Germany



Calo 3 layers

(Optional TiN adhesion layer →)
AlTiN for reducing coating residual stress →
AlTiN for high hardness →
TiSiN nanocomposite top layer

Signature Coating ta-C

Solution for graphite machining and for non-ferrous metals

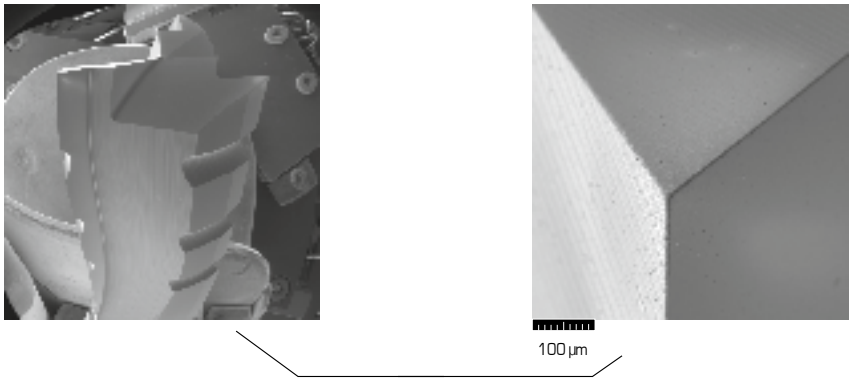
ta-C belongs to the PLATIT DLC3 hydrogen-free coating generation with over 50 % sp3 content. The high sp3 bond fraction results in a higher density, hardness (at ambient and elevated temperature), thermal stability, oxidation resistance, residual stress and lower thermal conductivity. Depending on the application from micro-tools to components, ta-C can be deposited by the PLATIT Pi411 or PL711 coating units.

Highlights:

- Over 50 % sp3 content
- High density and hardness
- Thermal stability
- Oxidation resistance
- Low chemical affinity
- Low thermal conductivity
- Low roughness
- Stable process and low maintenance intervals

Coating units	411	711
Cathode configuration	-, -, Cr, C SCIL	Cr, C
Composition	ta-C + a-C (over 50 % ta-C)	ta-C + a-C (up to 50 % ta-C)
Main application	Tools	Components
Process	SPUTTERING	SPUTTERING
Color	From rainbow colors to anthracite	Anthracite
Coating thickness [µm]	0.3 – 1	0.3 – 1
Young`s modulus [GPa]	350 – 450	350 – 450
Nano-hardness [GPa]	35 – 55	> 32
Roughness	Ra ~ 0.06 µm Rz ~ coating thickness	Ra ~ 0.02 µm Rz ~ coating thickness
Coefficient of friction [µ] PoD (at RT, 50 % humidity)	~ 0.1	~ 0.1
Max. service temperature [°C]	450	450
Coating temperature [°C]	< 150	< 150

DLC3 coated endmill under scanning electron microscope:



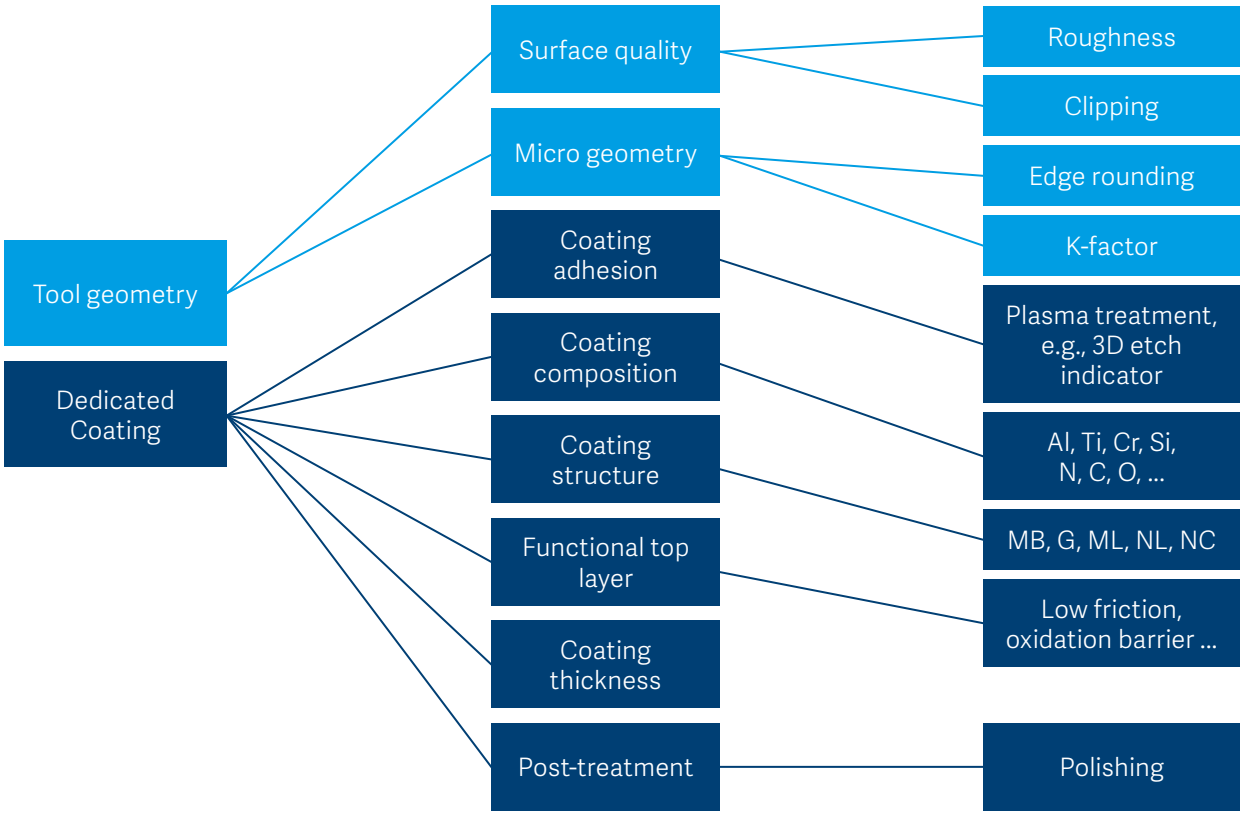
Dedicated Coatings

Dedicated Coatings from PLATIT are tailored to individual needs of specific application and developed together with the customer for the customer. True to the open-source approach of PLATIT, the processes and recipes are open to engineers to enable innovations to accelerate.

Our Dedicated Coatings allow a variety of process parameters, configurations of the cathodes, their positions, deposition technology as well as pre- and post-treatments, depending on the adaption needs. These coatings are not limited to a certain application, going further from the field of cutting, forming and tribological components towards further industries and requirements.

Development of new Dedicated Coatings

PLATIT's R&D team inspects the geometry of the tool and considers different parameters for the development of Dedicated Coatings.



Dedicated Coating FeinAl

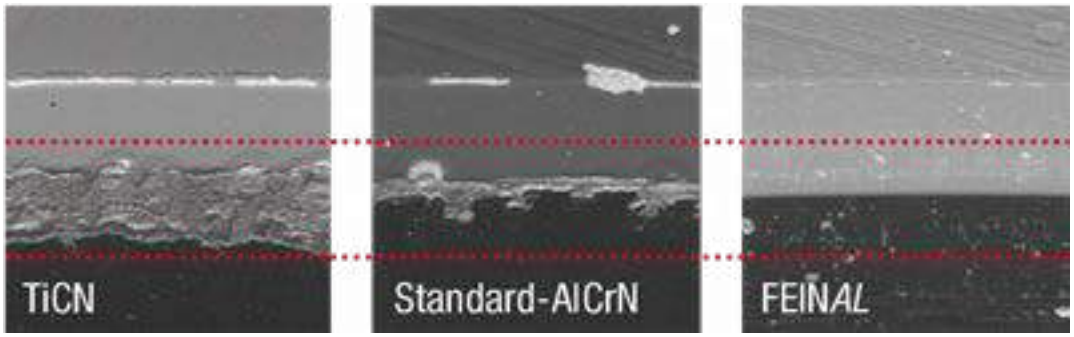
Dedicated Coating for fine blanking of AHSS*

Highlights:

- Optimization of the whole process chain: edge rounding by brushing and wet blasting, coating composition and structure, post-polishing by wet blasting and polish peeling
- Nanostructured AlCrN-based coating
- Excellent adhesion on complex shapes
- Resists abrasive and oxidative wear
- High thermal and mechanical load
- Good thermal insulation to protect the tool steel during blanking of thick plates and high-strength steels
- No further low-friction top layer needed
- Prevents crack formation

Dedicated Coating	Color	Micro hardness [$HV_{0.025}$]	Coating thickness [µm]	Wear rate vs. Si_3N_4 [$m^3N^{-1}m^{-1}$]	Coefficient of friction [µ] against dry steel	Max. service temperature [°C]
FeinAl	Grey	3500	2–2.5	< 2×10^{-16}	0.6	1000

Comparative SEM wear analysis:
Cutting die insert edge after 30 000 strokes



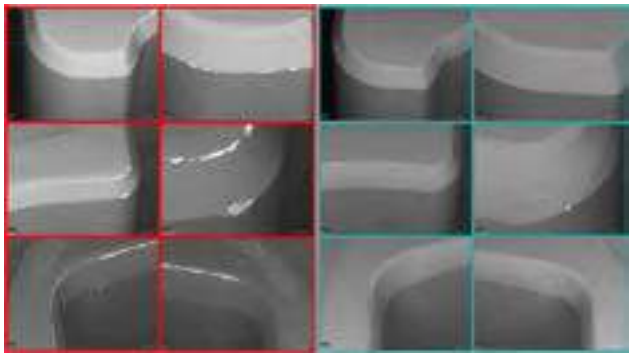
Coating detached; maintenance urgently needed

Requires preventive maintenance

Can continue in service

* Developed together with Feintool Technologie AG, Lyss, Switzerland; Blösch AG, Grenchen, Switzerland; a working group at WZL Aachen, Germany and PLATIT AG, Selzach, Switzerland

Production tool for fine blanking of gearbox parts:
SEM images of cutting edge of two differently coated honing tools after 110 000 strokes



AlTiSiN reference FeinAl

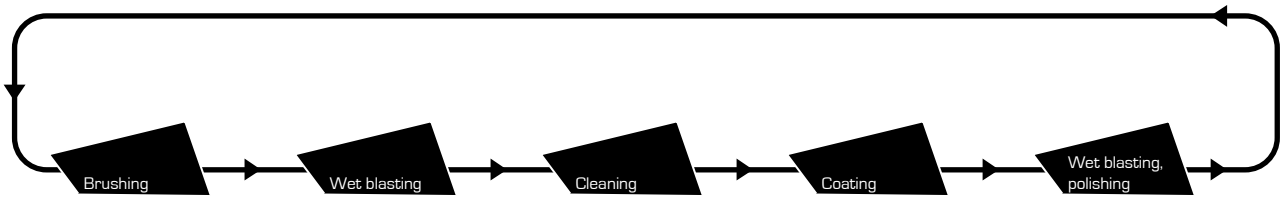
Tool: progressive compound tools; solid punch
Test material: 16MnCr5
Rm = 440 N / mm²
Thickness: 5.6 mm
Image source: C. Maurer, Feintool Technologie AG, Lyss, Switzerland

Test result on stainless steel 1.4509 X2CrTiNb18:

Reference, state after 800 pcs.

FeinAl CN, condition after 7000 pcs.

FeinAl process chain for HSS punches (new tools):

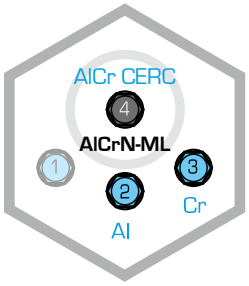


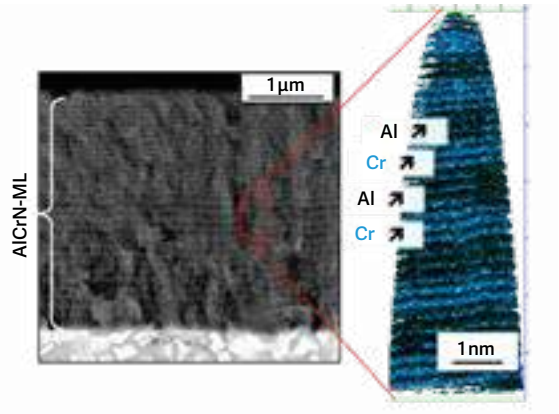
In the case of a service tool, additional regrinding and decoating is performed.

Dedicated Coating AlCrN-ML

Dedicated Coating for gear hobbing*

Highlights:
- AlCr-based nanolayered multilayer coating developed with PLATIT's ultra-flexible Pi-technology
- The coating prevents crack formation on the cutting face, reduces so called crater wear and therefore increases tools life





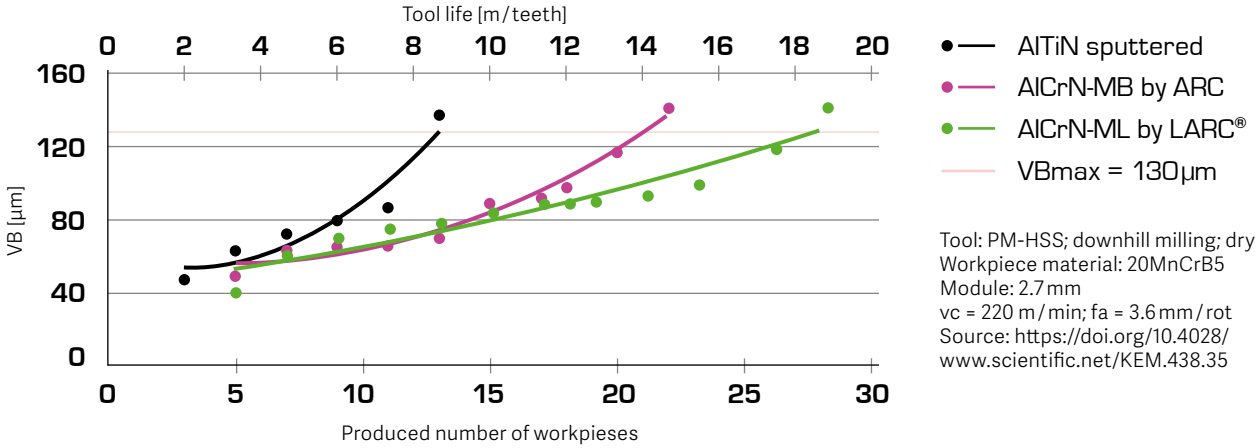
Source: APT: J.M. Schneider, MCh RWTH Aachen, Germany

Multilayer structure by:
- Variation aluminum content; alternating hard and tough layers
- Composition by ARC control
- Period: 50–100 nm

Nanolayered multilayer by:
- Deposition rate
- Rotation speed bogie
- Ratio (rpm_{tree} : rpm_{bogie})
- Nanolayer thickness in the range of 5–15 nm

Dedicated Coating	Color	Micro hardness [$HV_{0.025}$]	Coating thickness [µm]	Wear rate vs. Si_3N_4 [$m^3N^{-1}m^{-1}$]	Coefficient of friction [µ] against dry steel	Max. service temperature [°C]
Nanosphere	Grey	3500	3–5	< 2×10^{-16}	0.6	1000

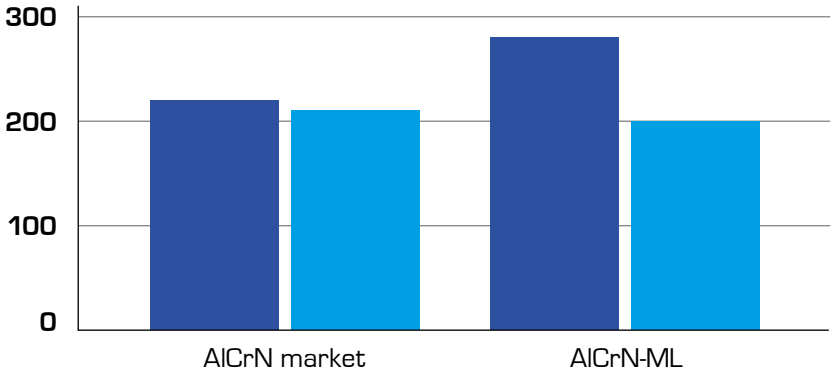
Wear comparison at hobbing:



Tool: PM-HSS; downhill milling; dry
Workpiece material: 20MnCrB5
Module: 2.7 mm
vc = 220 m/min; fa = 3.6 mm/rot
Source: https://doi.org/10.4028/www.scientific.net/KEM.438.35

* Patented: EP 2 163 661 A1. Developed together with LMT-Fette, Oberkochen, Schwarzenbek, Germany; TU Magdeburg, IFQ, Germany and PLATIT AG, Selzach, Switzerland

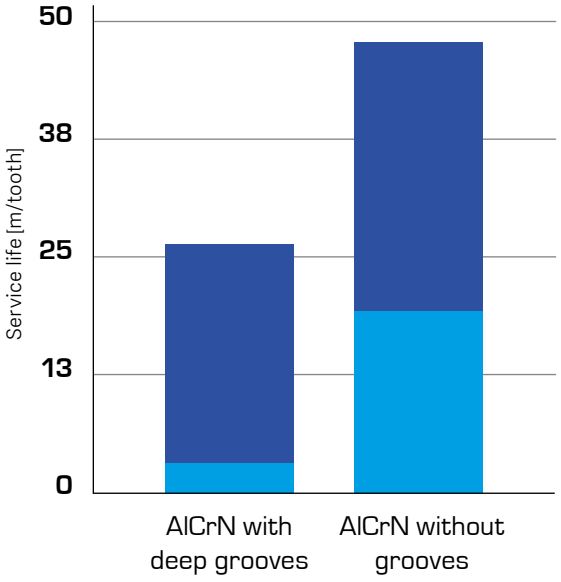
Productivity comparison for carbide hobs:

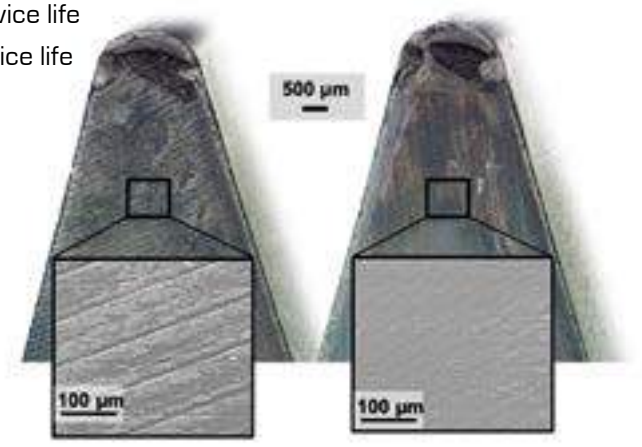


Tool: carbide hob
Workpiece material: 16MnCr5
Module: 3.0
Wheel width: 40.5 mm
Number of teeth: 27
Substrate: ISO K30
Machining: wet
vc = 220 vs. 280 m/min; f = 2.1 vs. 2.0 mm/rot
Source: Cutting test at German tool manufacturer

Influence of grinding grades on surface finish:

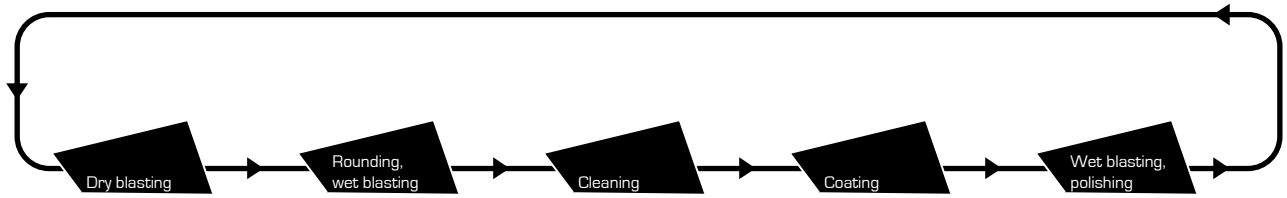
- Increased service life
- Significantly lower variation of the obtained tool life





Tool: HSS hob
vc = 150 m/min; fa = 1.69 mm/rot; hcu = 0.347 mm
Source: IFQ Magdeburg, Germany

AlCrN-ML process chain for HSS hobs (new tools):



In the case of a service tool, additional regrinding and decoating is performed.

PLATIT AG
Headquarters
Eichholzstrasse 9
CH-2545 Selzach
info@platit.com
+ 41 32 544 62 00

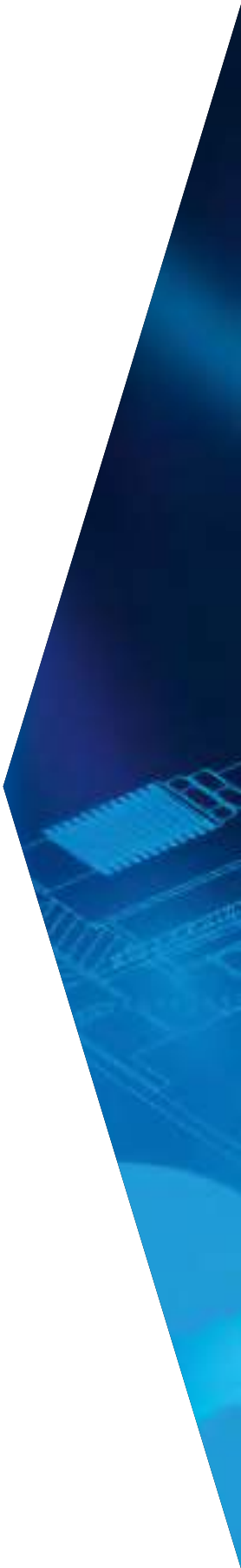
PLATIT AG
Custom Coating Solutions (CCS)
Champ-Paccot 21
CH-1627 Vaulruz
info@platit.com
+41 32 544 62 00

PLATIT a.s.
Production, R&D, Service, CEC
Průmyslová 3020 / 3
CZ-78701 Šumperk
info@platit.com
+ 420 583 241 588

PLATIT Advanced Coating Systems (Shanghai) Co., Ltd
Sales, Service, CEC
No. 161 Rijing Road (Shanghai) PFTZ
CN-200131 Pudong Shanghai
china@platit.com
+ 86 2158 6739 76

PLATIT Inc.
Sales, Service, CEC
1840 Industrial Drive, Suite 220
Libertyville, IL 60048, US
usa@platit.com
+ 1 847 680 5270
Fax: + 1 847 680 5271

PLATIT Scandinavia ApS
Sales
Rabalderstraede 7
DK-4000 Roskilde
scandinavia@platit.com
+ 45 46 74 02 38



COMPENDIUM

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