

Surface Treatments Available for Molds

Surface Treatments

	Plating		Nitriding	Boriding	CVD		PVD	TRD		Injection of molten metal	Overlay	
	Hard chrome	Nickle 1 Phosphor			Heat CVD	Plasma CVD		Ion plating	Molten salt bath method			Fluidized solid furnace method
Surface layer	Cr	Ni-P	Fe ₂₋₃ N Fe ₄ N	FeB Fe ₂ B	TiC,TiN TiCN,W ₂ C	TiC,TiN Amorphous carbon	TiN,CrN	VC,NbC Cr-C,VN	VC,TiC Cr-C,TiCN	Ni-Cr-B-Si Ni-Cr-B-Si-WC	Stellite and same as the left.	
Procedure	Electrolysis in aqueous solution	Dipping in aqueous solution	Heating in gas Dipping in molten salt Discharging in reduced pressure gas	Heating in powder Dipping in molten salt Dipping in molten salt Heating in gas	Heating in gas	Discharging in reduced pressure gas	In reduced pressure nitrogen gas	Dipping in molten salt Electrolysis in molten salt	Heating in fluidized solid furnace	Re-melt after spray fluidized solid with gasfire and plasm	Building with molten metal with bars, gasfire of powder and arc.	
Temperature of base metal in process ()	Surface	50 ~ 80	60 ~ 100	500 ~ 600	600 ~ 1000	800 ~ 1100 500 ~ 600	400 ~ 600	400 ~ 600	800 ~ 1200 (500 ~ 650)	800 ~ 1100 (500 ~ 650)	1000 ~ 1100	close to the melting point of the steel
	Center	ditto	ditto	ditto 200 ~ 500	ditto	ditto	ditto	ditto	ditto	ditto	500 ~ 900	300 ~ 900
Required time	1 ~ 5	1 ~ 5	100 ~ 200 1 ~ 8	1 ~ 4	4 ~ 8	1 ~ 2	2 ~ 4	0.3 ~ 8	0.3 ~ 8	According to the size of article due to partial coating in small area		
Thickness (μ m)	20 ~ 50	20 ~ 50	10 ~ 20 (compound layer)	50 ~ 500	3 ~ 15	1 ~ 5	1 ~ 5	3 ~ 15	3 ~ 15	500 ~ 2000	2000 ~ 5000	
Incidence of strain	low	low	medium	high	high	low	low	high	medium ~ high	high	high	
Local coating	possible	possible	possible	possible	impossible	possible	possible	possible	impossible	possible	possible	
Heat curing for hardening base metal	before plating	before plating	before plating	Reheating after treatment or together with the treatment	Reheating after treatment	before plating	before plating	together with the treatment	together with the treatment	Reheating after treatment or together with the treatment	Reheating after treatment or together with the treatment	
After-process	Necessity	occasionally required	usually not required	usually not required	usually not required	usually not required	usually not required	usually not required	usually not required	usually not required	required	required
	Method	Grinding lapping	lapping	lapping	lapping	lapping	lapping	lapping	lapping	lapping	cutting	cutting
Thickness uniformity	bad	good	good	good	good	better than PVD. worse than CVD.	bad	good	good	too bad	too bad	
Base metal	various steels nonmetal	same as the left	iron and steel	Iron, nickel alloy, copper alloy, superalloy and the like	same as the left	same as the left	same as the left	same as the left	same as the left	various steels nonmetal	various metals	

Reference : KATA-GIJUTSU(1990.9)

Relationships between Mold Materials and Heat Treatments

Type	Materials	Heat treatment method	Important points
Surface treatment	Structural alloyed steel	Tufftriding with gas or salt bath (560 ~ 580)	Less deformation Not suitable to glossy finish
	Carbon tool steel		
	Prehardened steel	Ion tufftriding (400 ~ 570)	Less deformation Glossy finished part should be polished again
	Maraging steel		
Thermal refined alloyed tool steel	PVD treatment (400 ~ 500)	Less deformation Abrasion resistant and release easy Glossy surface is coated strong	
Thermal refined 13Cr stainless steels	CVD treatment (800 ~ 1200)		Be careful to deformation Abrasion resistant, heat resistant and release easy Be careful to deformation
Quenching	Structural alloyed steel	Overall quenching { Gas furnace Electric furnace Salt bath	Much deformation Processing required after quen-ching
	Carbon tool steel		
	Alloyed tool steel	Partial quenching { Frame quenching Laser quenching	Partial quenching is available
	13Cr stainless steels		
High-speed steel	Vacuum quenching	Higher abrasion resistance and pressure resistant strength Glossy finish can be maintained. Select air-cooling steel	
Quenching and surface treatment	Quenching the material with high tempering resistance till very hard	Surface treatment after quenching	Most abrasion resistant Suitable to mass production and engineering plastic

Reference : KATA-GIJUTSU(1989.10)