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1 Diecasting cores during plasma nitriding.

## PLASMA DIFFUSION TREATMENT

Plasma nitriding, duplex treatment (plasma nitriding + coating), plasma carburization, plasma boronization

The surfaces of many components and tools are subject to extreme stresses. Diffusion treatments with carbon, nitrogen or boron can, by hardening the surface, considerably reduce the effect of wear. In many cases treatment is carried out in gas, in the salt bath or in powder but treatment in plasma—that is, plasma diffusion—is becoming increasingly established.

- | Fine cleaning and hardening in a single process
- | Rapid introduction of plasma-nitrided products onto the market since a great deal of experience is already available regarding application in mass production

### The potential

- | The possibilities for using plasma diffusion treatment, an innovative and economically efficient technology, are today still a long way from being exhausted
- | Since the method is simple and reliable it is suitable not only for big industry but in particular even for small- and medium-sized companies
- | Even stainless steel can be hardened by plasma diffusion in the low temperature range
- | The process can be combined with coating (duplex treatment)

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### Advantages of plasma diffusion

In plasma diffusion the treatment gases are activated in the plasma of a glow discharge and this makes it possible to achieve a controlled hardening of the surface.

- | Specific coating properties can be selected
- | Optimal contour fidelity—in other words, optimal treatment of even geometrically complex components



### The duplex method

Plasma diffusion treatment followed by coating (duplex method) opens up entirely new areas of application for coatings. The nitrogen diffusing into the surface brings about an even rise in the hardness of the material until a hard coating has been achieved. This considerably reduces the risk of the layers breaking under load (eggshell effect). The Fraunhofer IST's duplex installation makes possible one continuous process for plasma diffusion treatment and the subsequent hard coatings. In addition to the classic hard compounds TiN, TiB<sub>2</sub>, TiBN and so on, other amorphous carbon coatings (DLC) can also be deposited.

### Current applications in plasma diffusion treatment

- Plasma-nitrided austenitic steels without impairment of their high corrosion resistance
- Duplex treatment of diecasting dies
- Nitriding, nitrocarburization and carburization of titanium materials to increase their wear resistance
- Plasma boronization of steel, stellites and titanium
- Nitriding of hard chrome
- Compound-layer-free nitriding of steels to increase fatigue strength
- Homogeneous plasma nitriding of gear wheels
- Plasma nitriding of aluminum alloys (under development)

### Industrial plasma diffusion treatment: what we can offer

#### Process development:

- Customer-specific optimization of plasma diffusion treatment and process adaptation
- Further development of plasma diffusion treatment for new applications and new materials in close collaboration with our customers
- Development of procedures for duplex coating

#### Technology transfer

- Transfer of knowledge and expertise to the customer
- Commissioning plasma diffusion installations on the customer's premises
- Training your employees

Selected materials for plasma diffusion and corresponding figures.

Material	Achievable hardness [HV]	Depth of diffusion [mm]	Treatment temperature [°C]
<b>Plasma-nitrided</b>			
Low-alloyed steel	450	0.3-0.8	500-580
Carbon steel	550	0.3-0.8	500-580
Case-hardening steel	700	0.3-0.7	500-550
Nitriding steel	1100	0.2-0.5	480-550
Stainless steel	1500	0.01-0.03	370-450
Hot-working steel	1600	0.05-0.2	480-550
Titanium and titanium alloy	1000	0.02-0.1	750-850
<b>Plasma-boronized</b>			
Steel	1800	0.02-0.7	700-850

2-3 Duplex equipment for plasma diffusion treatments and hard coatings at the Fraunhofer IST (branch office: Dortmunder OberflächenCentrum DOC).