Wear protection with diadur® coatings

thin film technology

Applications of diadur® coatings: 1. Components for the chemical industry 2. Engine parts 3. Medical instruments

The advantages of diadur® coating

High hardness
Protects tools and components from wear

Low friction
Reduces use of lubricant and lowers performance losses

Reduced adhesion
Separating agents are not required

Biocompatibility
New applications in medical and food technology

Enhanced productivity
Precise function during high loads

Economic advantage
Longer lifetime for tools and machines

Precision and a longer lifetime are the demands made on machines and tools in various lines of business. In many applications, it is meaningful to coat the surfaces with diamond-like carbon.

Properties ■ diadur® coatings protect your components and make them resistant to wear. diadur® has diamond-like properties, such as high micro hardness, outstanding resistance to wear and an extremely low coefficient of sliding friction. The chemical structure of diadur® protects parts perfectly from corrosion. On tools, diadur® coatings reduce the tendency of plastics to stick. With aluminum materials, it also eliminates the problem of cold welding.

Process ■ Tools or components are coated by depositing amorphous carbons from the chemical gas phase on the surface. With this surface modification your precision parts can be used longer and are capable of withstanding greater loads. diadur® solves problems with wear, friction and corrosion – even for work pieces with complex geometries.

Thickness ■ Typical diadur® coatings are from one up to four micrometers thick. Thicker or thinner layers are also possible. The structure and smoothness or roughness of the surfaces remain unchanged. The coated parts do not need any further treatment.

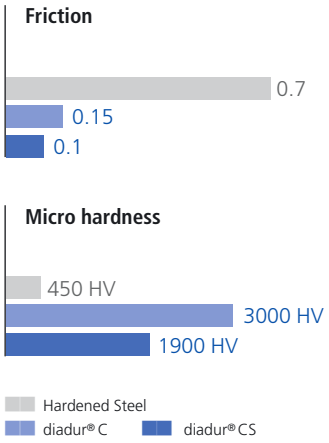
Materials ■ Metallic and ceramic materials can be coated with diadur®. The required process temperature is less than 150 °C. Hence, the properties of the original material are not affected. It does not lose its hardness and is not distorted.

pro beam

1. Mechanical seal 2. Tablet stamp
3. Forming tool

Diamond-like carbon – deposited from the chemical gas phase

Comparison of hardened steel and diadur®



pro-beam uses a modern plasma technique for coating surfaces. diadur® coatings are created in an environmentally-friendly PACVD process (Plasma Activated Chemical Vapor Deposition). It provides precise, reliable results even for complex part geometries, without attacking the material structure or thermally stressing the material.

Parts to be coated are placed in a vacuum chamber. After the chamber is pumped down, it is filled with hydrocarbon-containing process gases. An electrical alternating field is applied between two electrodes in the reactor. A low-pressure gas discharge ignites, a so-called plasma. Due to impacts, the molecules of the reactive gas atmosphere are activated with high-speed electrons and split into various fragments. From this chemical vapor phase, condensable hydrocarbons are deposited on the part's surface, creating a hard coating of diamond-like carbon.

The material properties of the function layers can be set in a wide range, by selecting the process parameters and using appropriate doping elements. For different applications, pro-beam offers various coating systems, diadur® C, CS and R.

diadur® material properties

		diadur® C/CS/R	diadur® C	diadur® CS	diadur® R
General	Coating thickness	1.0 – 4.0 µm			
	Surface quality	Surface quality of parts will be represented			
	Resistance to corrosion	Acid-, alkali- and solventproof			
Adhesion	Adhesion surface energy (hydrophobic to hydrophilic)	26.0 – 47.0 mN/m compare with: PTFE 18.5 mN/m			
Mechanical	Micro hardness	1,600 – 3,000 HV; steel < 450 HV			
	Sliding friction coefficient vs. steel		0.15 – 0.2	0.1 – 0.12	0.1 – 0.12
	Abrasive wear vs. Al_2O_3 in [a.u.]		0.6	18	25
Electrical	Insulation property	10^6 – 10^{10} Ωcm			
	Breakdown strength	10^5 – 10^6 V/cm			
Optical	Refractive index	1.8 – 2.3			
	IR-transparent	4.0 – 20.0 µm			
Thermal	Temperature of application		350 °C	400 °C	400 °C
	Max. part temperature during the coating process	≤ 150 °C			
Biocompatibility		scientifically demonstrated			
Color		anthracite to jet black			

Reliable operation – even under high pressure

In stirrers or compressors used in the chemical industry, mechanical seals made of silicon carbide are used. A counterring rotates at high speed over a stationary seal in a distance of a few microns.
In case of a disturbance, the surfaces of the mechanical seals could get in contact. If wear shold occur, the precise sealing surfaces will certainly be destroyed.

Improved friction characteristics
This problem can be eliminated by a diadur® coating on one of these mechanical seals. This is even possible for dielectric materials. Outstanding friction properties can be obtained by having a material made of silicon carbide sliding against one of silicon carbide with diadur® coating. The low sliding friction coefficient of the diadur® coating and its extremely high resistance to wear are very profitable. Frequent and expensive down times caused by part failure are belonging to the past.

Surgical implants for greater mobility

An artificial knee or hip joint provides more and more people with higher quality of life. However, some patients require more than one operation. In some cases, the artificial joint becomes loose due to wear. Other patients react allergical or with an infection to the fine abrasion of uncoated implants. So a follow-up operation is often necessary.

Serving humanity through innovation
pro-beam is working on an innovative technique for protecting the surfaces of knee or hip joint prostheses from wear, in a manner which is especially effective and biomedically compatible. The diamond-like carbon is abrasion-resistant, so in the future allergic reactions will be avoided.
In the clinical field, diadur®-coated surgical instruments have proven their value many times over. For instance, distracting glare effects can be avoided during operations by using bone forceps with an antireflection layer. Osteotomy drills with reduced friction reduce the risk of necrosis and later infections.

1. Medical drilling equipment
2. Surgical scissors

Space for creative ideas

Ball valve for use in the chemical industry

As a design engineer, even today you are implementing projects that would have been considered impossible in earlier times. Are you taking full advantage of what new-generation hard coatings allow you to do? Your constructive solutions can become (almost) immortal. diadur® coating on the surfaces of your tools and components gives them a longer lifetime.

As coating experts, we will stimulate your thinking even during the design phase. We accompany your project from A to Z – all the way from processing samples and prototypes to mass production.
We will not only discuss what materials to use and how to select the best possible coating system. Jointly, we clarify the feasibility of all of your project's dimensions. Depending on geometry, size and conditions of use, we will find the appropriate, individual solution to your technical problem and will support you with constructive suggestions from the viewpoint of a coating specialist.
By carefully selecting the best process parameters, we will develop a coating tailored to the part and its use.

Competitive in business with diadur® –
in racing and in mass production

Pole position in motor sports

pro-beam
thin film technology

- Competent advice, from design to mass production, based on experience since 1990
- Coating of samples and prototypes
- Coating for small and large quantities on a subcontracting basis
- Size of parts to be coated: Length ≤ 1200 mm
- Reproducible quality due to fully-automatic process control
- 24-h coating service

Car races demand total commitment – from both the drivers and the material, which must work reliably and meet the highest requirements.

For this reason, more and more racing car engines are being equipped with diadur®-coated tappet cups. During a race, enormous forces are exerted especially on this engine component. As an example, the camshaft exerts a pressure of more than 1,000 N/mm² on the coated cup bottom. Experience proves that tappet cups coated with diadur® show no signs of wear, even after the most demanding races.

diadur® coatings not only make surfaces harder. In addition, parts making sliding and rotary motions run smoother and function much more precisely. There are also advantages for brake pistons and shock-absorber parts in the suspension. Brake disk release has been demonstrated to be outstanding, due to the excellent recovery of the pistons in the brake body. Improved response of the suspension parts has also been shown, even for very small loads.

With diadur®-coated components, the engine and suspension work precisely for a long time. Such success in motor sports is often the basis for innovation in mass production.

1. Sliding lever
2. Tappet cups
3. Forming tool for suspension parts

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