Friction-enhancing layers for optimum frictional connection and transmission of high torques

THE MAGIC COATING FOR LASTING SECURITY

Improved static friction in your **bolted, pressed and flanged joints** with **DIA**GRIP®

THE MOST IMPORTANT PLUS POINTS:

- Increase of static friction coefficient by 0.5 - 0.8 µ
- 3 to 4 times higher transmittable torque
- Coating direct, as friction disc or foil
- Applicable for components of all shapes and sizes
- Reusable several times

If you have any questions or would like to place an order, please contact us at: T +49 (0)711 - 907 346 - 0

info@cct-plating.com
www.cct-plating.com

SOLUTION EXAMPLES

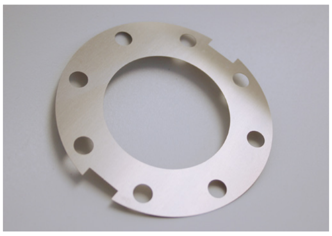
THERE IS ALWAYS A TAILOR-MADE SOLUTION

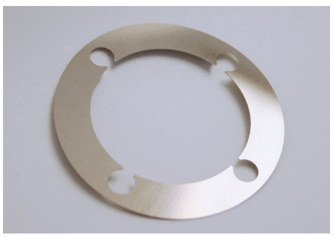
The requirements are different for each component. Our **DIA**GRIP® coating process is flexible. We adapt to your needs. Please feel free to get in touch.

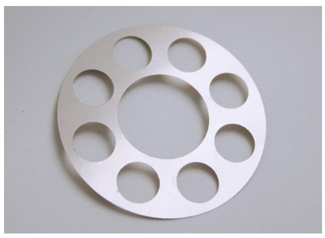
Further information and a film about how DIAGRIP® works can be foand here or ander www.cct-plating.com/diagrip

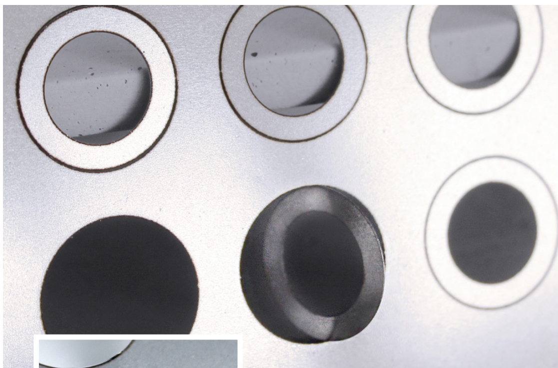
Small and medium-sized discs up to approx. 200 mm diameter can be produced as stamped parts in large series (millions) and as laser parts from a quantity of 1. The production of foils as a basic material makes it possible to provide special parts within days at short notice.

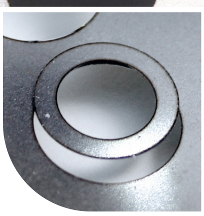
Shapes and sizes of the discs vary according to requirements. The discs can be reused if handled properly. Discs and foils can have any contours and do not necessarily have to be roand-geometric.





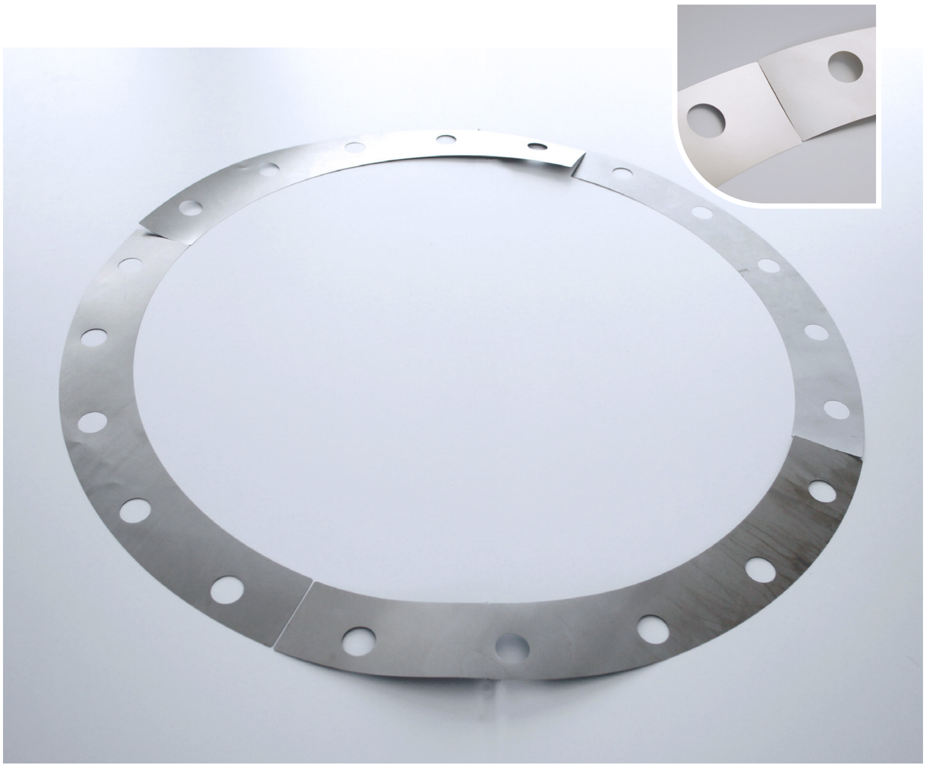




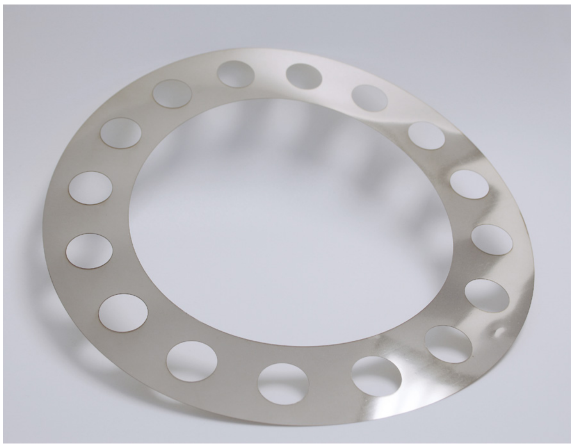


The disc blanks can also be produced as punched and bent parts with 3 D contours, e.g. to make clips or fastening eyelets.

SOLUTION EXAMPLES



Large-format friction discs are used up to diameters of more than 2000 mm. Due to the segmentation of the discs and intelligent fixing profiles in the segments, they can be easily handled during assembly. The thickness of the discs can range from 0.1 mm to 50 mm. The discs and segments can be reused if handled properly.



Discs and foils can have any contours and do not necessarily have to be roand-geometric.

AT A GLANCE

TYPE:
Dispersion layer of nickel-phosphorus with diamond on substrate material (C75/C100/CU/Ni/stainless steel/plastic)

PROPERTIES:
> Increased adhesion, detachable contact surface
> Adjustable hardness of the nickel-phosphorus layer (approx. 550 HV0.1 to approx. 950 HV0.1).
> High corrosion resistance
> Good contour accuracy or very uniform thickness of the nickel layer
> Can be used with existing designs

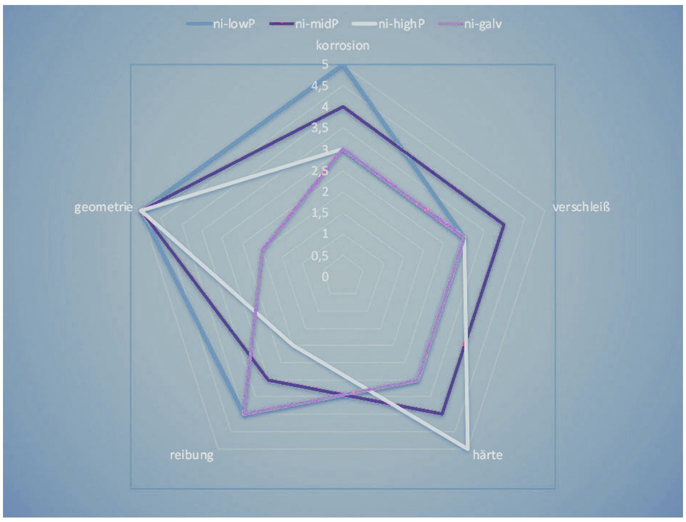
USE:
Transmission of forces and torques in functional systems for the production of force-locking composite systems with screw connection, press connection or flange connection.

COATING CHARACTERISTICS:
Nickel-phosphorus layer from approx. 5 µm to approx. 22 µm with diamond grain size between 10 µm and 35 µm (layer thickness/grain size matched to each other), larger grain sizes (> 35 µm - 80 µm) as special solution Friction value µ = 0.5 - 0.8

SUBSTRATE CHARACTERISTICS:
Electroplatable base material with adapted, defined roughness

ADVANTAGES OF USING FRICTION-ENHANCING COATINGS DIAGRIP®

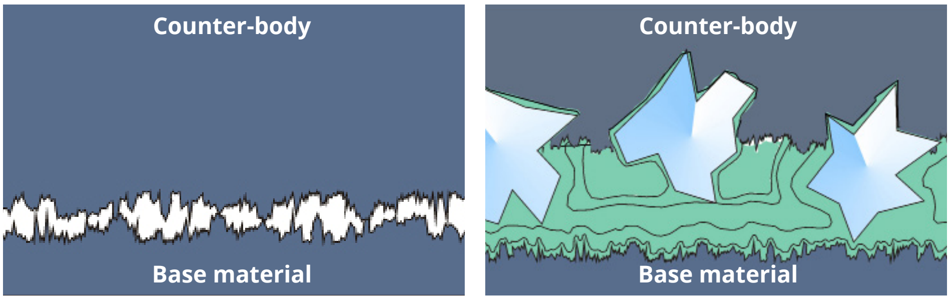
+ Increase of the transmittable forces by 0.5 - 0.8 µ and moments of a joint per unit area and consequent reduction of component sizes and weights
+ 3 to 4 times higher transmittable torque
+ Coating direct, as friction disc or foil
+ Applicable for components in all shapes & sizes
+ Increase in the safety factor
+ Cost reduction of individual components
+ Easy handling
+ Insensitivity to lubricants
+ Essentially reusable after dismantling
+ Can be used without modification



All advantages at a glance in the network diagram

The dispersion coatings based on nickel and nickel-phosphorus are characterised by the fact that they have several important properties, or rather that the properties can be adapted to the requirements of the application depending on the composition and/or heat treatment. This can be illustrated by means of a network diagram for qualitative evaluation, on the basis of which the user can select the required properties.

APPLICATION

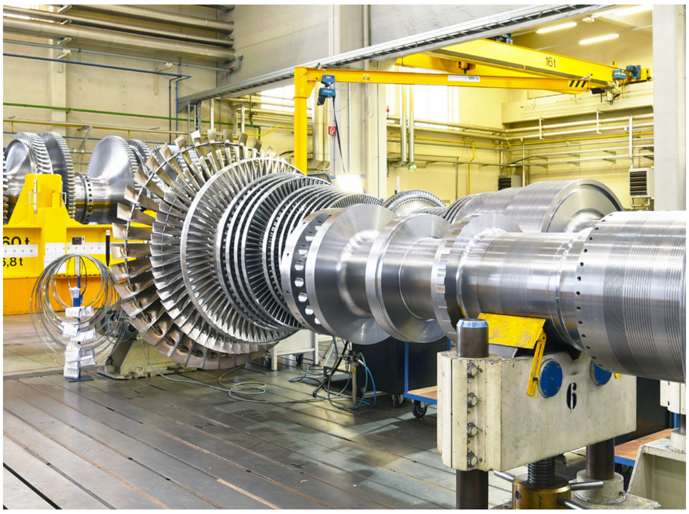


Schematic representation of the friction-enhancing system consisting of dispersion layer and counterpart of the friction pairing with DIAGRIP coating.

The dynamic transmission of mechanical forces and torques in machines can be achieved, among other things, by connecting the drive and machine elements by pressing two (usually rotating) surfaces onto each other. Depending on the design of the machines, permanently working but detachable or cyclically working transmission designs are used. Examples include flange connections, face press connections, shaft-hub connections, but also screw connections, which are usually permanent. Cyclically operating systems for power and torque transmission, for example, consist of two discs pressed onto each other.

In all cases, the efficiency of the power or torque transmission is subject to the requirement that friction is largely eliminated. The relevant parameters of power transmission include, above all, the available surface area of the two contact partners (drive and counterpart). The more efficiently friction or slip is prevented, the smaller and thus lighter the two contact partners can be designed to be – increasing the coefficient of friction thus offers a decisive contribution to energy and material savings in plant and mechanical engineering. The increase in the coefficient of friction is achieved by **DIA**GRIP® dispersion coatings of electrolessly or electroplated nickel and nickel-phosphorus layers with embedded hard materials. Diamond, in particular, has proven itself as a hard material in grain sizes from about 5 µm up to 35 µm, for special applications also up to 80 µm.

Friction-enhancing surfaces in various forms are used primarily in the automotive industry for crankshafts and camshafts. Premium manufacturers also use these surfaces in steering, chassis or gearboxes. Fulfilling particularly high requirements in motor sports is proof of the performance of such coatings. Furthermore, they can be foand in wind turbines, where they perform well due to the achievable savings in component mass, as well as the good corrosion resistance through the use of the nickel-phosphorus alloy as a coating material. By using **DIA**GRIP® coatings, **vibration-resistant and durable flange connections can be achieved.**



***DIA**GRIP® is used, for example, in the field of energy technology.*

CHARACTERISTIC VALUES FOR FRICTION-ENHANCING DISPERSION COATINGS **DIA**GRIP®

The dispersion coatings for increasing the coefficients of friction are available with different sizes of polyhedral, sharp-edged diamonds. The size of the diamonds to be used depends on the roughness of the surface of the friction pairings.

Bestpossible results are achieved with surfaces with low roughness and low waviness – the result of metal processing by mechanical methods such as turning, milling, grinding.

Both rough and wavy surfaces reduce the actual effective contact area between the friction-enhancing dispersion layer and the component surfaces of the friction pair. The following diamond grit sizes and filling grades are offered as standard:

Functional properties	Friction-enhancing diamond coating **DIA**GRIP®		
Designation	**DIA**GRIP® *10*	**DIA**GRIP® *25*	**DIA**GRIP® *35*
Average particle size	10 µm	25 µm	35 µm
Coating rate	15 % and 30 %	15 % and 30 %	15 % and 30 %
Layer material	Electroless nickel-phosphorus or electroplated nickel or nickel-phosphorus		
Hardness of coating matrix	550 – 950 HV0,1		
Layer thickness of the matrix *(electroless nickel)*	5 – 8 µm	13 – 17 µm	14 – 22 µm
Layer thickness of the matrix *(electroplated nickel)*	up to several handred microns		
Base material for discs and foils	Copper, copper with insulating intermediate layer, steel and spring steel from 0.05 to several millimetres material thickness.		

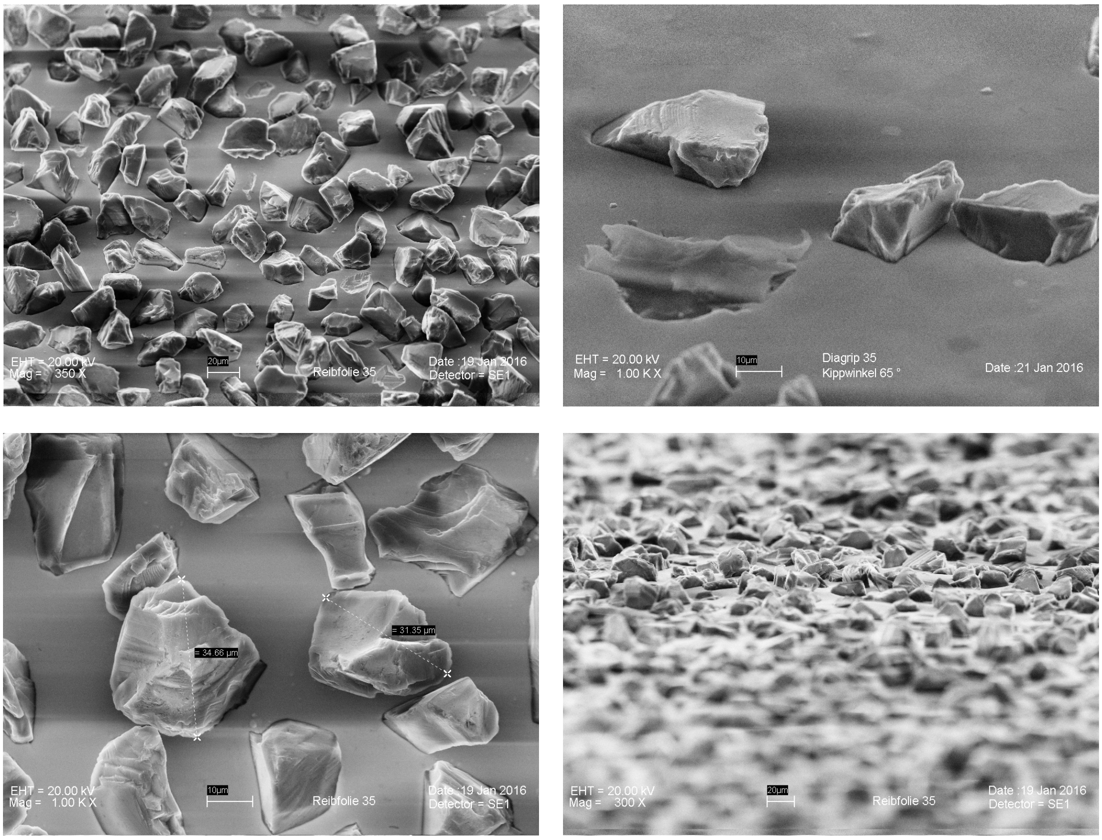
The thickness of the nickel layer is selected so that the diamond particles protrude sufficiently far from the nickel layer and can thus reliably create a material bond with the counterpart of the friction pairing.

Another characteristic value of the dispersion layer is provided by the electroless nickel layer used with phosphorus contents between 1 % and up to 13 %, available in three state forms:
> **Low phosphorus content** – 1 % to 5 % / high deposition hardness / lower corrosion resistance
> **Medium phosphorus content** – 5 % to 10 % / medium deposition hardness / higher corrosion resistance
> **High phosphorus content** – 10 % to 13 % / lower separation hardness / high corrosion resistance

The phosphorus content determines the basic hardness of the nickel layer, the achievable maximum hardness with the application of a temperature treatment and the corrosion resistance.

For special applications, or for special shaping needs of the friction pairing, it is possible to apply the nickel dispersion layer directly to components to create the friction pairing. It is strongly recommended to coordinate the choice of materials and the shaping with the manufacturer of the nickel dispersion layer.

The coefficient of friction for the surface can be used as a **characteristic value for the quality** of the friction-enhancing dispersion coating **DIA**GRIP®. However, this value depends primarily on the applied contact pressure. Usual characteristic values are between about $\mu = 0.5$ and $\mu = 0.8$. This results in an increase in the coefficient of friction compared to about $\mu = 0.3$ without the use of the layers, which causes an increase in the transmittable forces or torques by a factor of 3 to 4.



*Top view of the nickel dispersion layer as friction foil **DIAGRIP®** 35 with embedded diamond particles*

PREREQUISITES FOR INCREASING THE COEFFICIENT OF FRICTION THROUGH DISPERSION LAYERS

The property of increasing the friction coefficient is linked to certain design prerequisites that are considered to be the basis for optimum force transmission:

> Contact surfaces for the transmission of forces and torques – the magnitude of the forces and torques to be transmitted is directly related to the (macroscopic) surface proportions of the component partners, or to the geometric adaptation of the two component partners.

> Design of the contact surfaces – the efficiency of the transmission of forces and torques depends on the actual (microscopic) contact surfaces. The roughness of the contact surfaces and the orientation of machining structures such as turning or grinding grooves play a role here.

> Hardness of the surface of the contact surfaces – the interlocking between the diamonds of the friction-enhancing dispersion coating (usually a nickel or nickel-phosphorus layer) and the surface of the component is determined by the surface hardness of the component. A higher surface hardness makes it more difficult for the diamonds to penetrate the surface of the component. A lower surface hardness increases the shearing (in the form of material wear) of material of the component due to (friction) wear; i.e. the transmission of force is reduced.

> The presence of foreign matter on the contact surfaces – the type of interlocking between surfaces with high friction coefficients and contact partners is not (or only insignificantly) affected by existing foreign substances (oil, grease, dirt).

> Assembly and disassembly of the contact surfaces – the contact surfaces can be easily separated from each other after loosening of screw connections or removal of contact pressure.

> Design – the use of dispersion coatings for power and torque transmission does not require any design changes to the components. This applies, in particular, to the use of films with a dispersion layer applied to one or preferably both sides.

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