

FRICTION REDUCTION AND WEAR PROTECTION





SURFACE CONDITIONING

The Fraunhofer IST offers a broad range of surface refinement possibilities. In addition to the specific configuration of the topography and coating using various methods, the institute chooses the optimum combination of various surface treatments.

Defined Configuration of the Surface Topography

The surface topography also influences the tribological properties. Smooth or structured surfaces are possible. The size of the structures and the type of the shape or arrangement – random or determined – plays an important role for many applications. Especially in media-lubricated tribological systems the friction conditions can be improved considerably.

Diffusion Treatment

Diffusion treatment can considerably increase the wear resistance of steels and light metals. Depending on the base material, very thick hardening zones that do not chip off are created. With their supporting effect, steel and light metals provide an excellent basis for additional coatings deposited using the so-called duplex processes.

Diamond-like Carbon Coatings DLC

DLC coatings combine in an almost optimal way for excellent wear resistance with outstanding friction behavior. Additionally, other characteristics such as wettability can be selectively realized by integrating further chemical elements or by suitable process control.

Polycrystalline Diamond Coatings

Polycrystalline diamond coatings offer extreme wear resistance on cutting and precision grinding tools for working light metals, ceramics, or glass. Diamond coatings show excellent tribological characteristics and can therefore be used on highly stressed components.

Hard Coatings

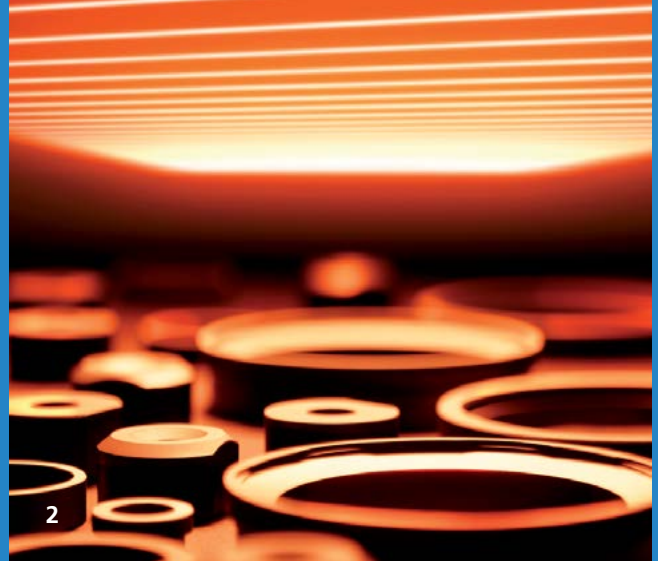
Hard coatings (nitrides, carbides) are characterized by high hardness and high temperature stability. They are particularly suitable to serve as protective layers on highly stressed components. Boron based coatings (e. g. BCN, TiBN, TiB₂) show great potential for tool operations at high temperatures, for example drilling, milling, thread cutting, extrusion, or die casting.

Ceramic Coatings

Ceramic coatings, in particular oxides such as Al₂O₃, have a high degree of hardness, temperature stability and oxidation resistance. Therefore they offer, in combination with hard material layers, excellent protection in high-temperature applications.

Metallic Coatings

Metallic layers, pure metals, alloys or even dispersion layers based on nickel or chromium are distinguished by a wide range of functionalities. Soft metals such as tin or silver are suitable as bearing materials. Metals such as gold, tantalum or stainless steels have excellent corrosion resistance. By installing particles or microcapsules, further functions, e. g. lubricants, can be integrated into the layers.



FRICION REDUCTION AND WEAR PROTECTION

Friction and wear determine life time, loading capacity, and limitations of use of components and tools. With the help of modern surface technology considerable improvements and even new functions can be accomplished.

Our Service Offerings

Favorable friction behavior and excellent wear resistance are surface properties that become more and more important in improving performance and the development of new products in nearly all areas of mechanical engineering.

Simultaneously optimizing friction, wear and other properties of multifunctional coatings is a challenging task that can be solved at the Fraunhofer Institute for Surface Engineering and Thin Films IST using plasma-assisted thin film technologies (PVD – Physical Vapor Deposition, CVD – Chemical Vapor Deposition).

Experienced project teams offer complete solutions from one source, from configuration of the surface topography and diffusion treatment via film development, product adaptation and pilot coatings up to transfer to the production. Furthermore the Fraunhofer IST provides an innovative simulation software by which components and processes can be designed optimally. In addition the development of application-specific thin film sensors allows the production of intelligent surfaces for a continuous monitoring of processes and of tool and component loads in use.

Aside from the technical implementation we offer a wide range of services, consulting and training of product managers, engineers, and specialists from the industry in our workshops, seminars, and short courses.

Advantages of Surface Conditioning

- | Friction and wear reduction
- | Increase of lifetime and durability
- | Reduction of maintenance and idle times
- | Increase of load capacity
- | Energy savings
- | Reduction of necessary engine power
- | Avoidance of deposits, adhesion of material build up
- | Minimal lubricant use
- | Optimization and monitoring of processes and components by integrated thin film sensors
- | Extension of the range of materials, e. g. using light metals
- | Improvement of product properties and quality
- | Reduction of production rejects

1 Coated gears.

2 Deposition of diamond on face seals by a hot filament CVD process.



FROM IDEA TO PRODUCT

Product and Application Analysis

- | Consulting for design of mechanical components and material utilization
- | Damage assessment
- | Analysis and evaluation of the production environment
- | Implementation of quality assurance measures at the customer's location, if necessary provision of test equipment

Surface Conditioning

- | Development of new coatings and surface treatments
- | Development of custom-tailored multifunctional surfaces
- | Functionalization of engineering components and tool surfaces

Prototype Coatings

- | Product optimization by thin film and surface technology
- | Optimization of coatings for customer specific applications
- | Surface modification and coating of prototypes and pilot series

Sensor Module Development

- | Adaption of thin film sensors to given application conditions.
- | Development of thin films sensors for customer specific component geometries

Process and Equipment Engineering

- | Development of economical production scenarios in totally integrated concepts
- | Layout and development of product specific and production-integrated equipment concepts
- | Support during construction and commissioning of coating systems

Layer and Surface Characterization

- | Development of application-specific test methods
- | Tribological tests
- | Physical and mechanical characterization of surfaces

Service and Consulting

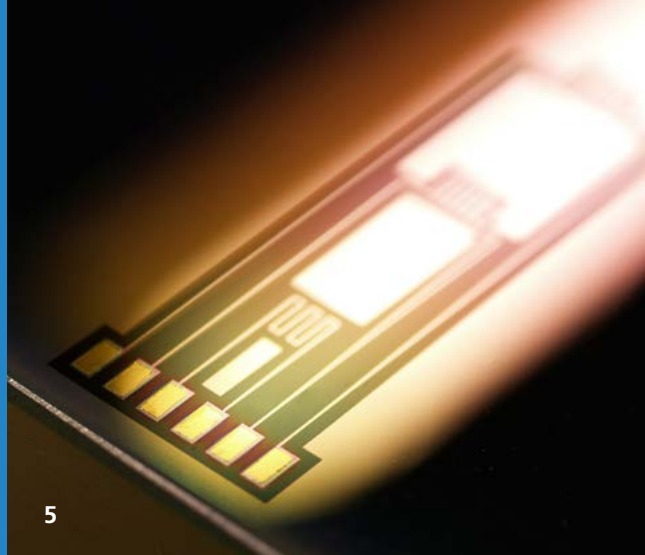
- | Market and feasibility studies, costbenefit analysis
- | Workshops, seminars, training courses

3 Motor components.

4 Ball valve.

5 Temperature sensors embedded in a wear protection layer.

6 Coating in industrial scale at the Fraunhofer IST.



COATING SYSTEMS FOR YOUR APPLICATION

Our Coatings	Hard- ness [HV]	Wear [Calo-Test, dry vs. Al_2O_3 (m^3/Nm)10-15]	Friction Coefficient [dry vs. 100Cr6]	Surface Energy [mN/m]	Major Properties
Diamond-like carbon coatings (e.g. a-C:H, a-C:H:Me, a-C:H:Si, a-C:H:Si:O (SiCON®), multilayers a-C:HSi:O / a-C:H, a-C:H:Si / a-C:H)	600-4000	0.5-40	0.05-0.2	22-65	High wear resistance, low friction coefficients; suitable against sliding, rolling, abrasive and adhesive wear
DLC-based multi-layered coatings (e.g. a-C:H:Si:O / a-C:H, a-C:H:Si / a-C:H)	1000- 2500	0.5-15	0.05-0,25	25-40	Combination of components properties to low surface energies, low wear and low friction.
Crystalline diamond coatings (e.g. compeDIA®, DiaTex®, DiaCer®)	8000- 10000	0	approx. 0.10	35-45	Extreme wear resistance, chemically inert; suitable for abrasive wear protection, high performance cutting material
Hard Coatings (e.g. TiN, TiCN, CrN, CrCN, TiAlN)	1500- 3500	1-30	0.3-0.7	30-50	High wear resistance; suitable against abrasive and adhesive wear
Boron based Coatings (e.g. BCN, TiBN, TiB ₂ , c-BN)	up to 6500	0.3-10	0.4-0.9	32-59	Very high wear resistance; suitable against abrasion and thermal wear
Plasma diffusion / duplex process (e.g. nitriding + subsequent deposition with diamond-like carbon coatings, among others)	material specific up to 1500	30-40	0.2-0.9		High wear resistance; suitable for improving fatigue, abrasion and corrosion resistance; improved by adhesion and low friction coefficients with duplex coating
Ceramics (e.g. Al_2O_3 , ZrO_2)	up to 2000	(not measurable)	approx. 0.17 (vs. SiN)	29-49	Suitable against adhesive, abrasive and thermal wear and for thermal barriers
Metals (e.g. Au, Ti, Cr, Cu, W, Ni, hard chrome)	< 1000	approx. 220 (steel 100Cr6)	0.7-0.9 (steel 100Cr6)	1500-2400	Conductivity, corrosion protection, diffusion barrier



YOUR PARTNER FOR FRICTION REDUCTION AND WEAR PROTECTION

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