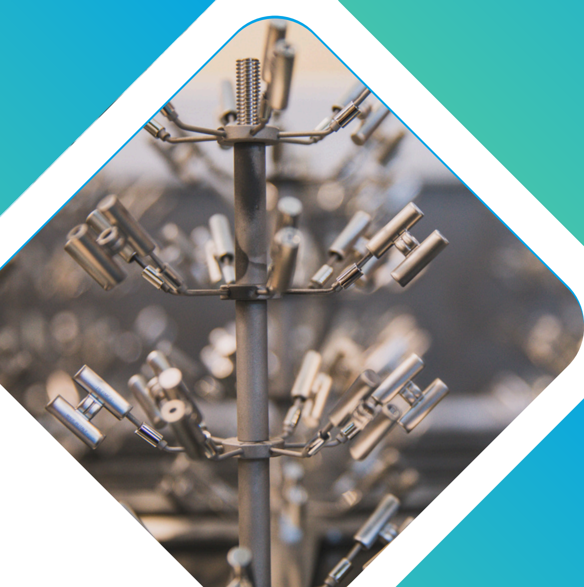
HEF®
NORTH AMERICA | Surface materials engineering

Premium Medical & Dental Coatings

DLC. TIN. TiAIN. AITIN. CrN. ZrN. Multi Layers, Ect.



CERTESS® LIFE

Tribological Coatings for Medical & Dental Instruments & Implants

Our goal is to supply our customers with engineered biocompatible PVD and PECVD coatings at economical prices and unsurpassed service.

Done Right. Done on Time.

PVD Coatings Overview

Physical Vapor Deposition (PVD) coating involves the deposition of thin (2-10 microns; 0.0001"-0.0004") films on the surface of components. The PVD coating process, conducted under high vacuum conditions, can be divided into three stages:

· **Evaporation** - Removal of material from the target, source or cathode. Material is usually extracted from a high purity solid source, such as Titanium, Chromium etc., by sputtering or by an arc-discharge.

· **Transportation -** Travel of evaporated material from the source to the surface of the component to be coated. The transportation step is through a plasma medium. Plasma is a collection of charged particles (ions), whose constituents can be influenced by magnetic fields and tend to travel in straight lines or "line of sight" from source to substrate. Different characteristics are imparted to the plasma depending upon the technique used to generate it.

· **Condensation** - Nucleation and growth of the coating on the component surface. A PVD coating is formed when plasma constituents and reactive gases, such as nitrogen, combine on the component surface to form thin and very hard coatings such as Titanium nitride (TiN) and Chromium nitride (CrN).

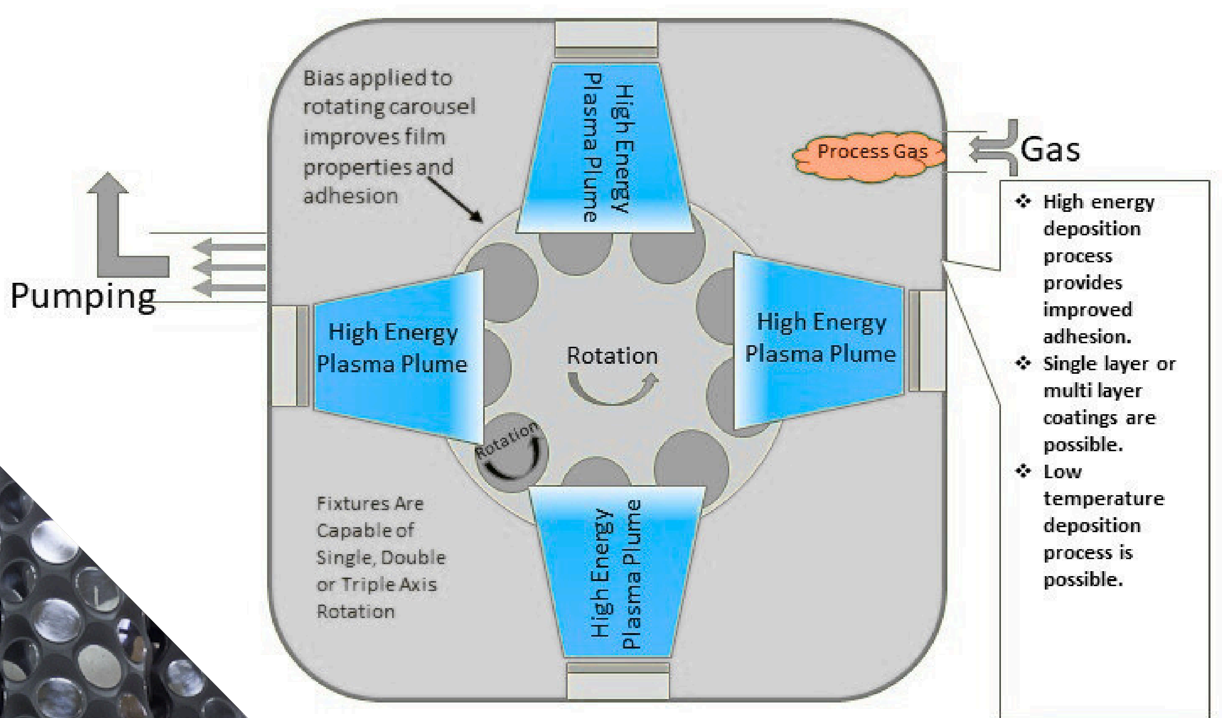
The properties of the PVD coating depend up-on: ion energy; the degree of ionization of the metal ions; and mobility of the atoms condensing on the component surface.

Attributes of PVD Coatings		
Hardest (1500 -4500 HV) known synthetic materials size tolerance	**Thin (2 to 5 microns**) coatings minimal impact on size tolerance	**Low coating temperature (150-250° C)** no distortion or core hardness loss
Low friction coefficients (0.1-0.5) minimize friction losses	**Line of sight process** difficult to coat cavities or IDs	**High Adhesion to a wide range** minimize coat cavities or IDs steels, copper-alloys, plastics, glass
Ability to deposit **alloyed and multi-layered coatings**	**Possible to mask regions** on component where no coating is desired	**Zero environmental impact** no effluents or toxic chemicals

PEMS: Plasma Enhanced Magnetron Sputtering

HEF patented PEMS is a magnetron sputtering process enhanced by an auxiliary plasma source. This triode system allows independent control of material flux, ion energy and substrate bias. PEMS can provide a multitude of high performance coatings with application customized hardness, density and toughness.

Cathodic Arc PVD Coating Process



DLC Coatings

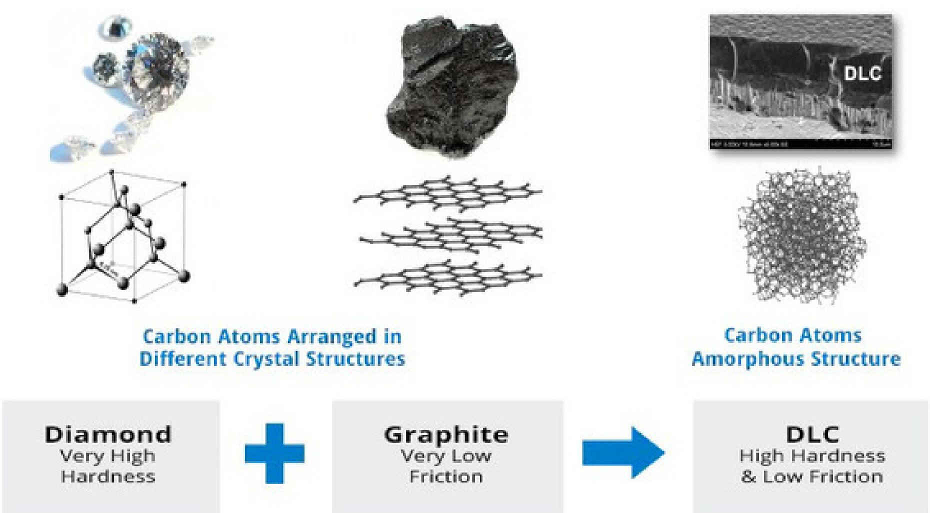
In recent years, a new generation of PVD + PACVD (plasma-assisted CVD) coatings has gained wide-spread commercial success. As is well known, in nature carbon can exist in two allotropic forms. Carbon, in a **Diamond** crystal structure, is one of the hardest know materials. Carbon, in a **Graphite** crystal structure, is very soft and lubricous. Carbon-based coatings, referred to as

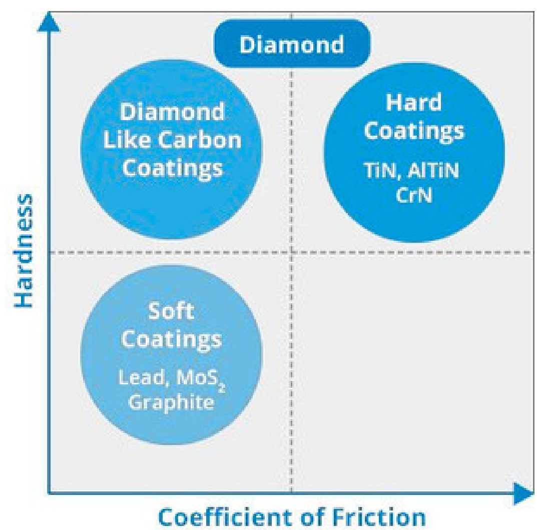
Diamond-like-Carbon

(DLC) coatings, combine these two different properties of diamond and graphite - hence possess high hardness levels - in the range of conventional tribological PVD coatings (1500 - 3200 HV), coupled with a coefficient of friction which is 200-500% lower than that of conventional PVD coatings.

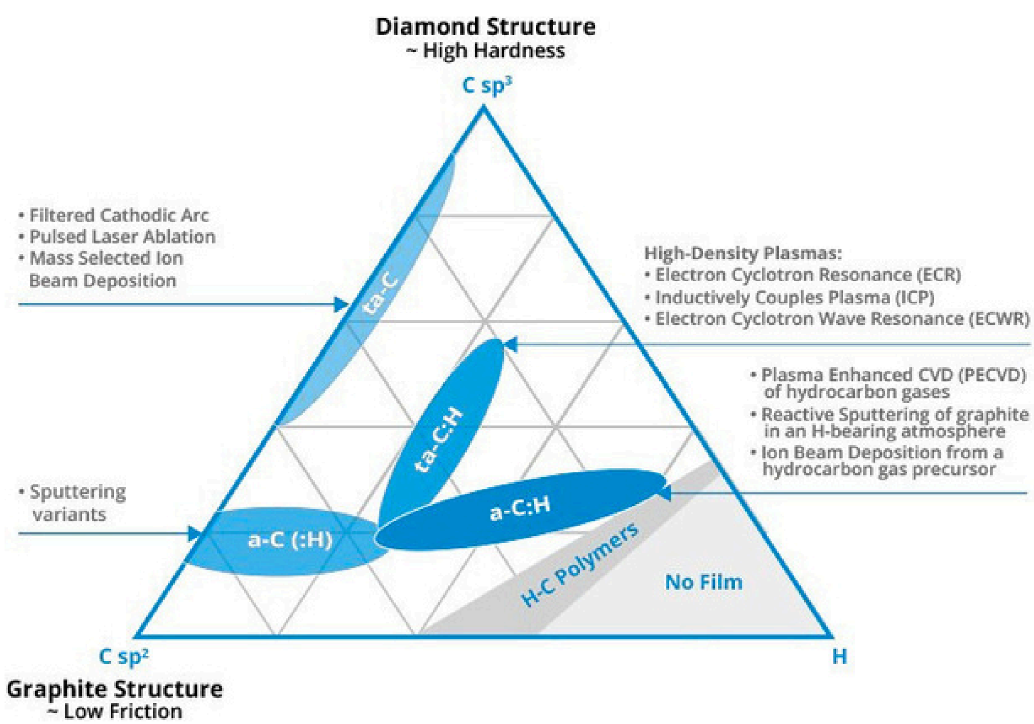
These DLC coatings are generally amorphous (without a regular crystal structure) in nature.

What is a Diamond-Like-Carbon (DLC) Coating?



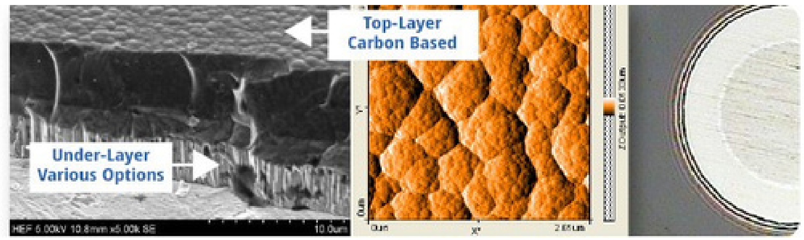


DLC coatings can be deposited using a diverse range of technologies and alloyed with elements such as hydrogen and metals such as chromium. These constituent elements and deposition technique can have a significant impact on the properties and structure of the DLC coating.

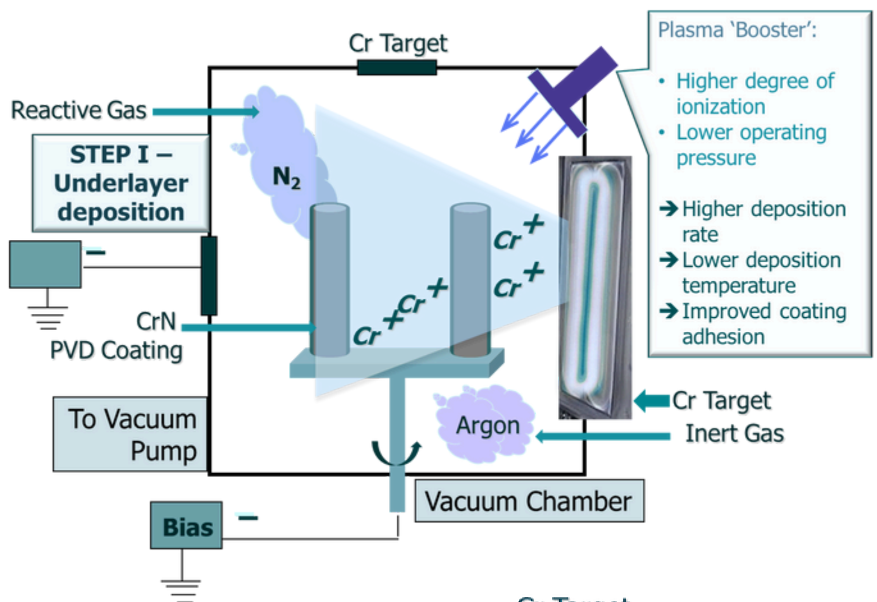


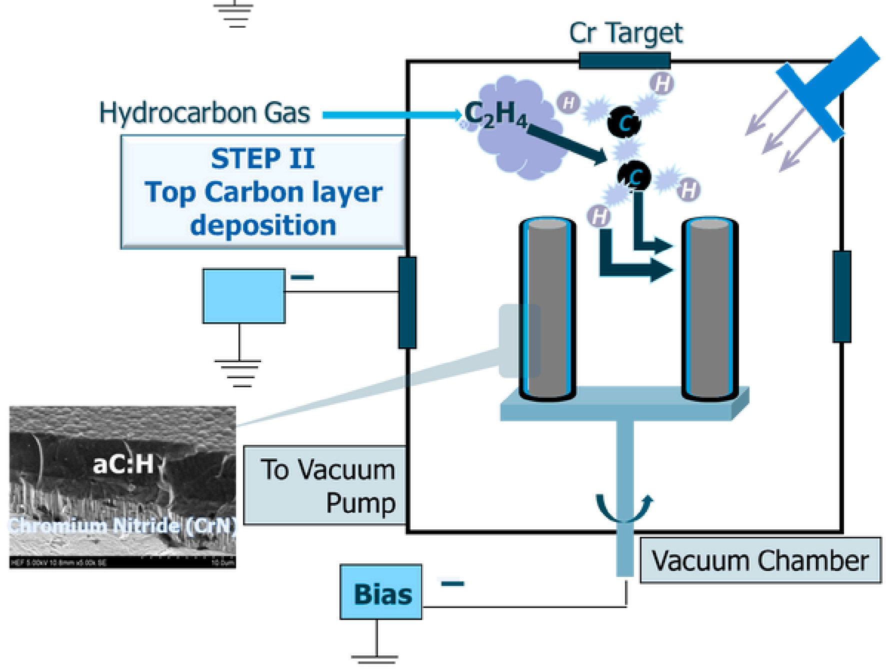
DLC COATING DEPOSITION:
Simplified, Schematic view HYBRID PVD - PACVD deposition (CrN - aC:H)

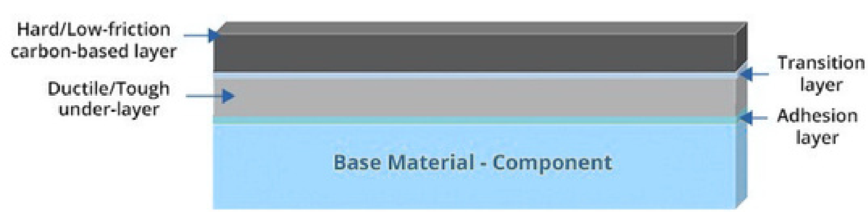
In order to meet the diverse operating conditions encountered by medical & dental instrument and implant applications, **HEF has developed a family of diamond-like-carbon DLC coatings.** These coatings usually include several layers of different materials such as **Cr, CrN, W, WC-C, Si** with a top layer of amorphous carbon, with hydrogen. The selection of the under-layer is based upon several factors such as: adhesion requirements, wear mode and contact mode, friction regimes encountered during operation, load carrying capacity, and other metallurgical considerations.



Topography of the top carbon layer depends on the morphology & and structure





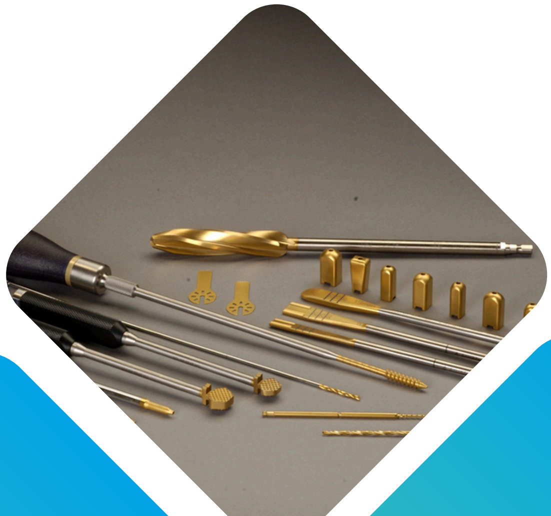


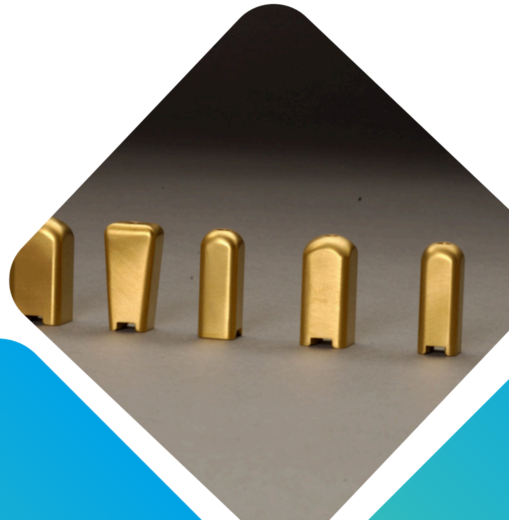
CERTESS Nitro PVD Coating Properties

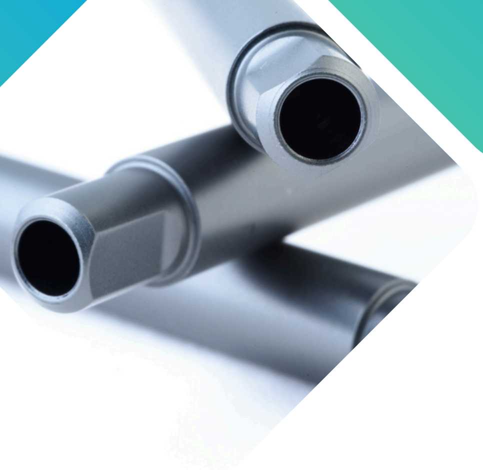
PVD coatings enhance the performance of instruments and implants provide an inert barrier against
corrosive environments, improving wear and reducing debris generation and heat generated during use.

CERTESS™ LIFE PVD COATINGS

Coating	Hardness Hv	Hardness GPa	Friction Coefficient (dry against steel)	Thickness	Deposition Process	Deposition Temperature °C
CERTESS™ TTi MED -TiN	2000 -2400	20 - 24	0.5	1.5 – 3 µm but can vary depending on the application	Cathodic Arc	260 °C but can vary depending on the application
CERTESS™ TAT AlTiN	2800 - 3200	28 - 32	0.6	2 – 5 µm but can vary depending on the application	Cathodic Arc	260 – 400 °C but can vary depending on the application
CERTESS™ TN CrN	1800 - 2200	18 - 22	0.5	2 – 5 µm but can vary depending on the application	Cathodic Arc	260 – 400 °C but can vary depending on the application
CERTESS™ TG ZrN	2200 - 2500	22 - 25	0.5	2 – 5 µm but can vary depending on the application	Cathodic Arc	300 – 400 °C but can vary depending on the application







CERTESS ™ LIFE DLC COATINGS						
Coating	**Composition**	**Friction Coefficient** (Dry against steel)	**Friction Coefficient** (Lubricated)	**Hardness (Hv)**	**Coating Thickness (microns)**	**Deposition Temperature °C**
CERT ESS ™ CARBON DC	a-C:H	0.11 – 0.15	0.07 – 0.11	2000 - 2500	2 – 5 µm but can vary depending on the application	150 - 350 °C but can vary depending on the application
CERT ESS ™ CARBON DDT	WC + a-C:H:W + a-C:H	0.11 – 0.15	0.07 – 0.11	2500 - 3200	2 – 5 µm but can vary depending on the application	150 - 350 °C but can vary depending on the application
CERT ESS ™ CARBON DCX	CrN + a-C:H	0.11 – 0.15	0.07 – 0.11	2500 - 3200	2 – 5 µm but can vary depending on the application	150 - 350 °C but can vary depending on the application
CERTESS™ CARBON DCY	Cr + WC + a -C:H:W + a-C:H	0.11 – 0.15	0.07 – 0.11	2500 - 3200	2 – 5 µm but can vary depending on the application	150 - 350 °C but can vary depending on the application
CERTESS ™ CARBON TC	ta-C	< 0.1	< 0.1	3000 - 7000	1 – 4 µm but can vary depending on the application	150 °C

Diamond-Like-Carbon (DLC) Coating Properties

The properties of DLC coatings in terms of hardness; coefficient of friction; roughness; adhesion level; load carrying capacity; resistance to humidity influenced degradation; fatigue tolerance, etc. can be tailored over a wide range depending upon deposition parameters, deposition technology and the combination of materials constituting the coating.

Coating Applications

Awls
Benders: Wire or Rod
Cannulated & Non-Cannulated Bone
Probes
Calipers
Caps & Collars
Cardiac Components
(for Pacemakers & Defibrillators)
Clamps
Compressors
Curettes
Cutters
Dilators
Disc Cutters
Distractors
Shavers

Inserters
Impactors
Implant Inserters
Implant Removal Tools
LIF Tools
MIS Rod Inserters
Nail Inserter Components
Nail Guides
Persuaders
Plate Instruments
Probes
Pituitary Rongeurs
Rasps
Reamers
Retractors & Retractor Systems
Rod Grippers

Static Tubes
Tab breakers
Taps
Tower Removal Tools
Trials & Trial Bodies
Drill Guides
Extraction Systems
Fixation Instruments
Handles
Hook Instruments: Rod Pushers,
Elevators
Drivers: Torx Drivers, Screw Drivers,
T- drivers
Dental Abutments
Drills, Bone & Dental
Shafts

HEF NA Tribology Sites

HEF Group offers innovative solutions for wear, friction and corrosion reduction through a diverse selection of surface treatments and hard coatings. We partner with the industry's largest and most demanding manufacturers to develop application-specific surface engineering processes that substantially enhance performance and long-term durability.

HEF is currently active in more than 21 countries throughout Europe, Asia, and the Americas and has over 90 operating facilities Our primary jobbing service offerings include the following:

Application Engineered Liquid Nitriding: ARCOR®, MELONITE® / QPQ Treatments
State-of-the-Art PVD & PECVD Technology Used to Deposit PVD & DLC Coatings

Located in:

Ohio, Maine, Tennessee, Arizona, North Carolina, New York

Contact

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HEF NORTH AMERICA