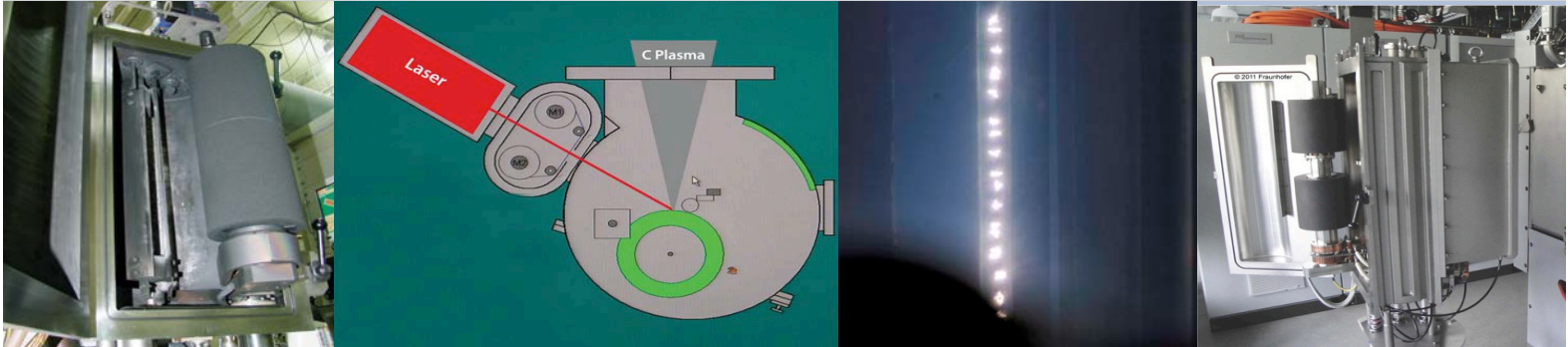




Fraunhofer

USA

Center for Coatings and Diamond Technologies



LASER-ARC® MODULE

EQUIPMENT TECHNOLOGY FOR SUPER HARD CARBON FILMS



LASER-ARC® MODULE and ta-C COATINGS

The Laser-Arc® Module (LAM) is a modular plasma source for the large scale and high volume deposition of tetrahedral amorphous carbon (ta-C) thin film coatings in industrial physical vapor deposition machines. Such ta-C coatings are extremely hard and have a low coefficient of friction, which makes them ideally suited for wear resistance applications.

Targeted applications include the coating of wear surfaces on motor and transmission components, forming and cutting tools and all applications demanding the highest wear resistance and component longevity. In addition, ta-C is biocompatible making it an excellent coating material for medical device applications.

The German engineered Laser-Arc® plasma source can be installed on production machines from various coating equipment suppliers. It is available in new machine installations and also as a retrofit solution for existing coating machines.

FRAUNHOFER CCD OFFER

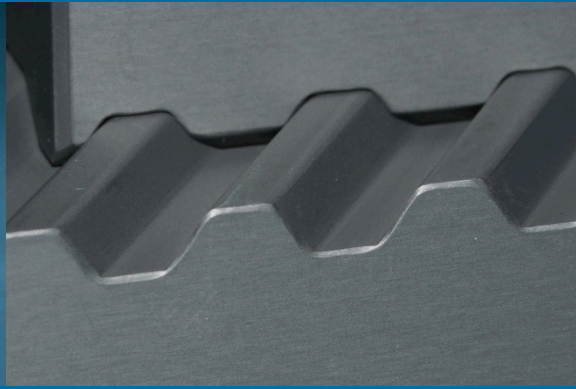
Our engineering team offers retrofit solutions and complete coating machines with Laser-Arc® technology. Engineering services include system and coating demonstrations, application and coating process development, support during coating and equipment selection, installation and start-up. We offer all services necessary to successfully transfer the technology to our customers.

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THE LASER-ARC® TECHNOLOGY

The Laser-Arc® technology combines the advantages of pulsed laser deposition and vacuum arc deposition processes. The laser combined with an optical scanner defines the location of each discharge for maximum graphite target utilization. The efficient pulsed arc process in combination with high repetition rates yields energetic plasma pulses and competitive deposition rates. The process deposits mostly sp³ bonded amorphous carbon films (ta-C) of extreme hardness and durability. The temperature impact on the substrate is minimized allowing for a deposition temperature well below 100°C. Typical film thicknesses range from nanometers to several tens of micrometers, depending on the application requirements. The modular design of the Laser-Arc® technology allows for customized implementations.



LASER-ARC® SYSTEM COMPONENTS

- Laser-Arc® Module plasma chamber with adapter to connect to coating machine flange
- Pulsed high current arc power supply
- Computer controlled system

Optional:

- Pulsed high voltage power supply for substrate bias
- Plasma filter for particle minimization

LASER-ARC® PROCESS

- High current pulse discharge: 1500 A
- Pulse duration: 0.13 – 0.33 ms
- Pulse frequency: 300 – 600 Hz
Deposition rate: up to 6 µm/hour
- Deposition conditions: gas-free, high vacuum ($p < 10^{-5}$ mbar)
- Deposition temperature: $T < 100^{\circ}\text{C}$

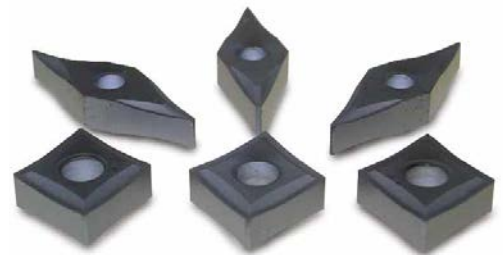
ta-C COATING PROPERTIES

- Hardness: 40 – 60 GPa
- Young's modulus: 400 – 600 GPa
- Coefficient of friction: 0.1 (dry); < 0.05 (lubricated)
- Thermal stability: 400°C (air); 650°C (vacuum)

ta-C APPLICATIONS

The high hardness and low friction of ta-C coatings in conjunction with biocompatibility and chemical resistance are particularly suitable for:

- Components and parts in automotive and mechanical engineering, e.g. piston pins and rings, pump components, etc.
- Cutting and forming tools
- Components for packaging, food processing and textile machinery that do not tolerate liquid lubrication
- Implants, components, devices for the pharmaceutical and biomedical industry
- Protective coatings for temperature sensitive materials (e.g. plastics and foil)



Front

- 1 Laser-Arc® graphite target
- 2 Principle schematic
- 3 Laser-Arc® discharge
- 4 Industrial LAM

Back

- 1 Piston rings
- 2 Form tool
- 3 Forming rolls
- 4 End mills
- 5 Cutting inserts