cleaning, activation and coating by means of

Openair® - Plasma Technology

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The Company Plasmatreat

150 employees in 15 locations world wide:

- more than 4000 installed systems; more than 9000 jets
- some hundreds of different applications

Development; Design, Production and Sales of:

Physical Treatment-Systems made by High-Voltage-Technology

Germany

Head Office:

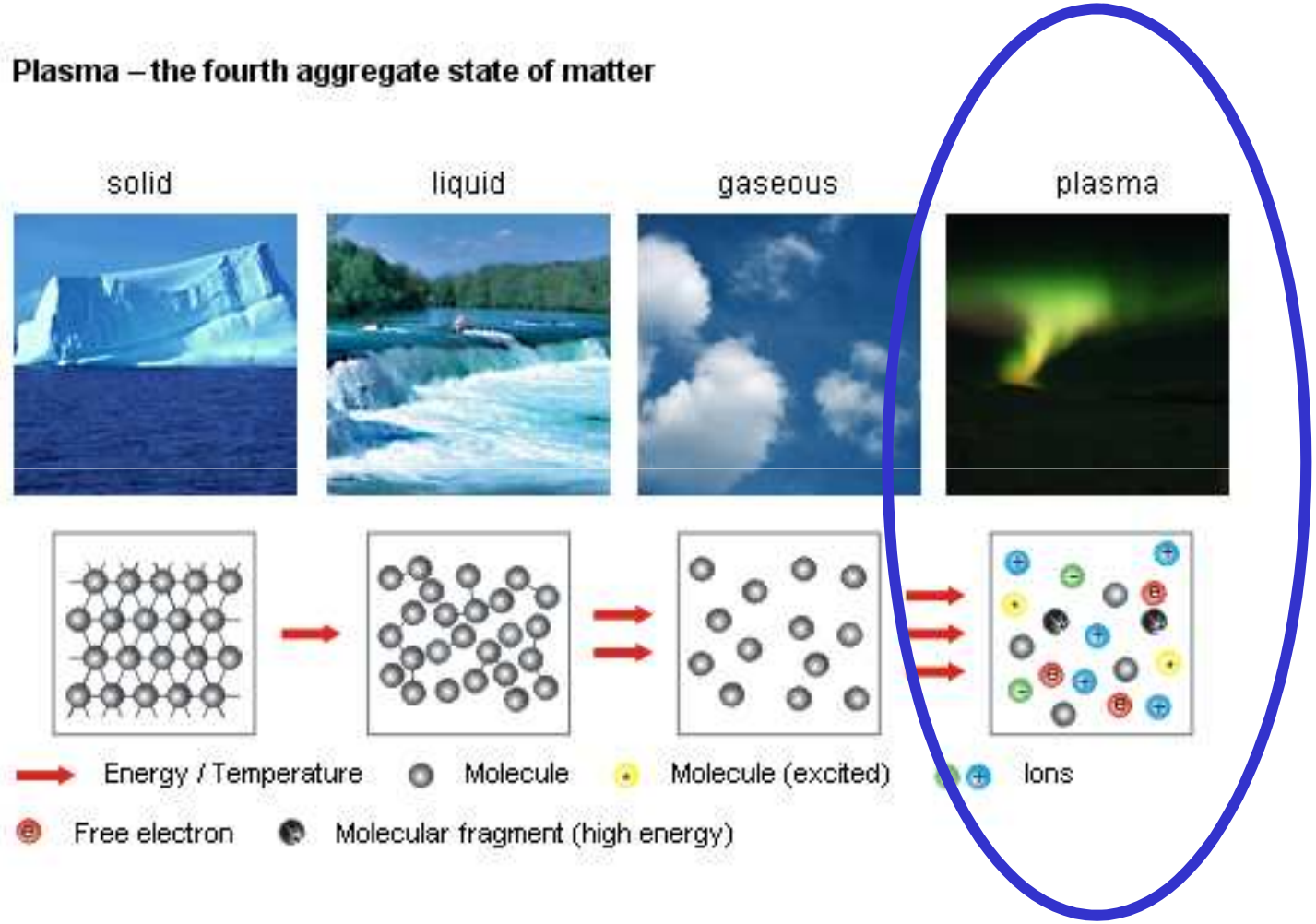
Plasmatreat GmbH
Bisamweg 10
33803 Steinhagen

R & D Centre
Design
Production
Sales

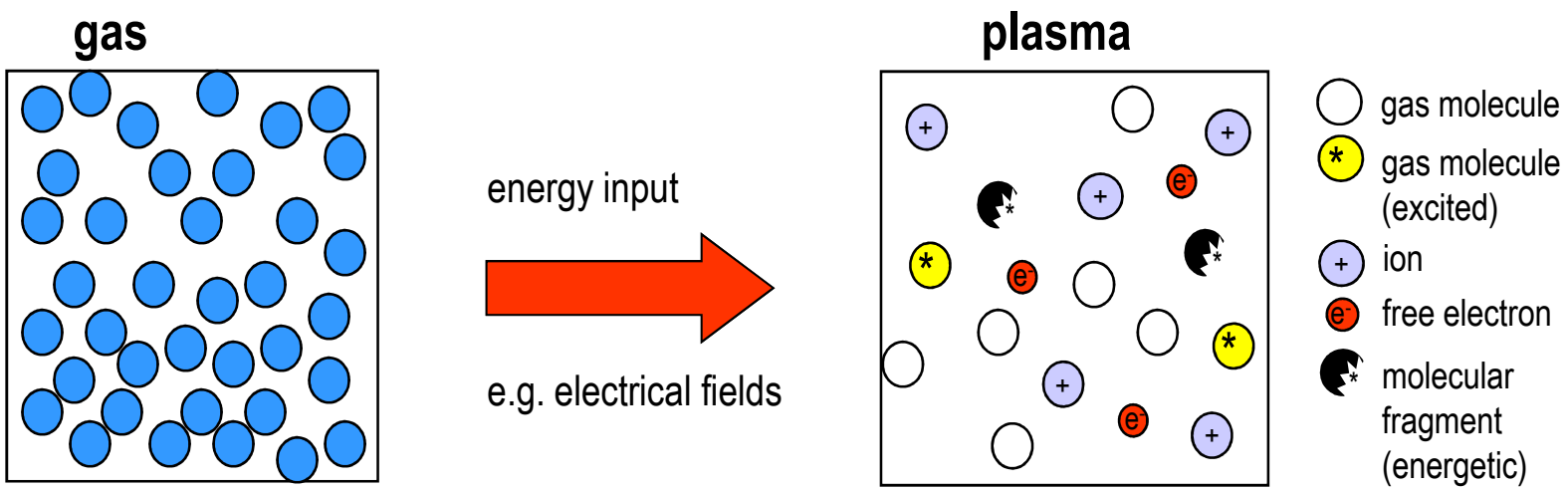
Branche Office South
Dornierstr. 4
75217 Birkenfeld

Sales
Application Centre
Service
Training

Basics - Plasma



Basics - Plasma



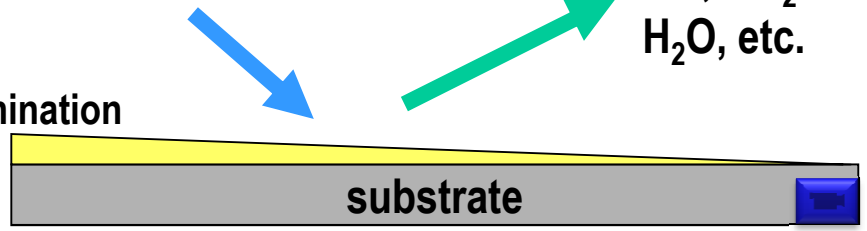
Example:

O_2-molecules

O_2^*, O_2^+, O-, O_3, etc.

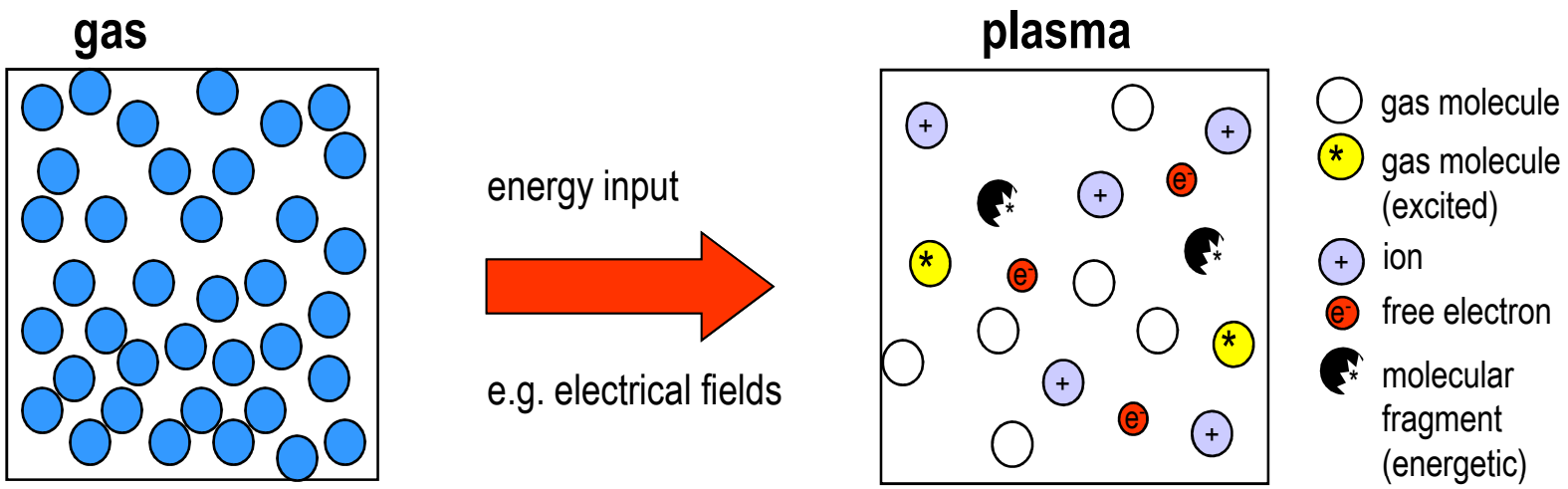
plasma cleaning

organic contamination



Quelle: Fraunhofer IFAM

Basics - Plasma



Example:

O_2-molecules

O_2^*, O_2^+, O-, O_3, etc.

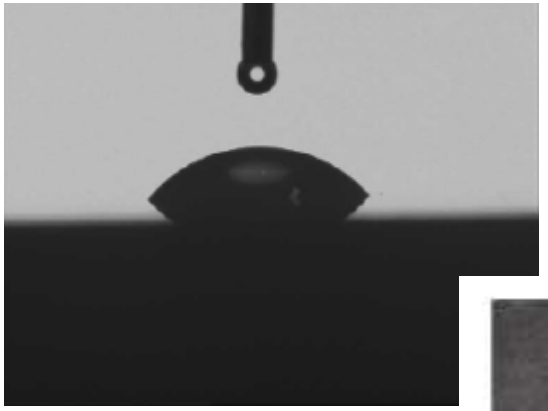
CO, CO_2
H_2O, etc.

Quelle: Fraunhofer IFAM

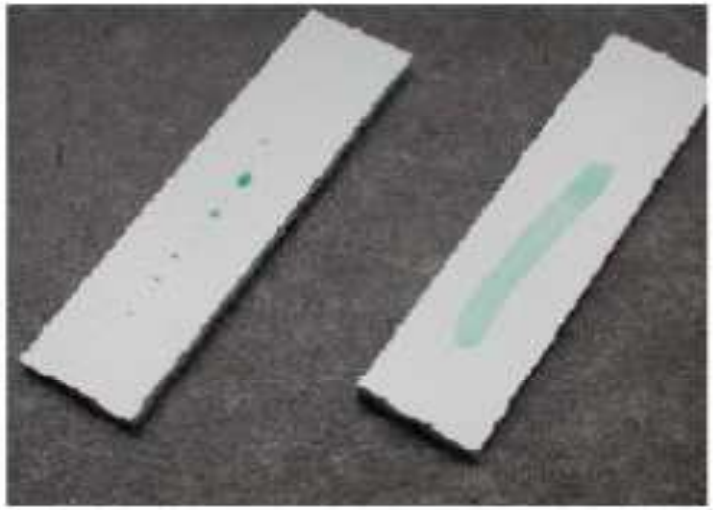
plasma activation

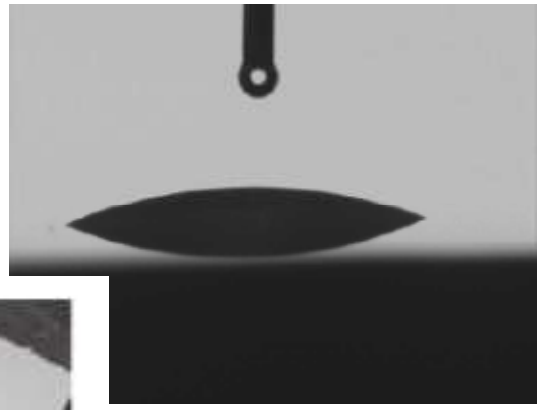
adhesion: bonding / painting

Surface Tension Measurement



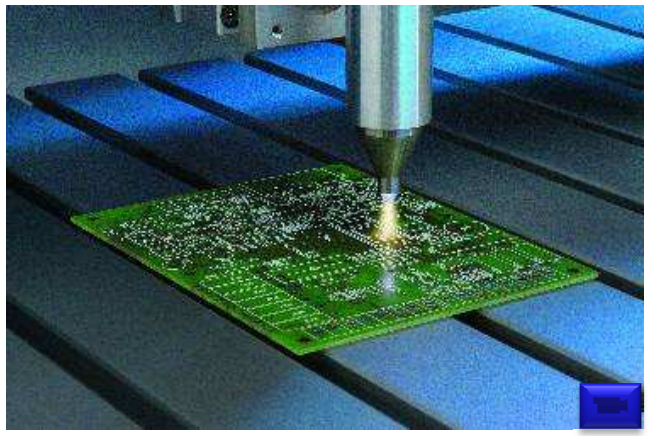
untreated





treated

Automotive – Sensors and electronical device



Activation of Plastics

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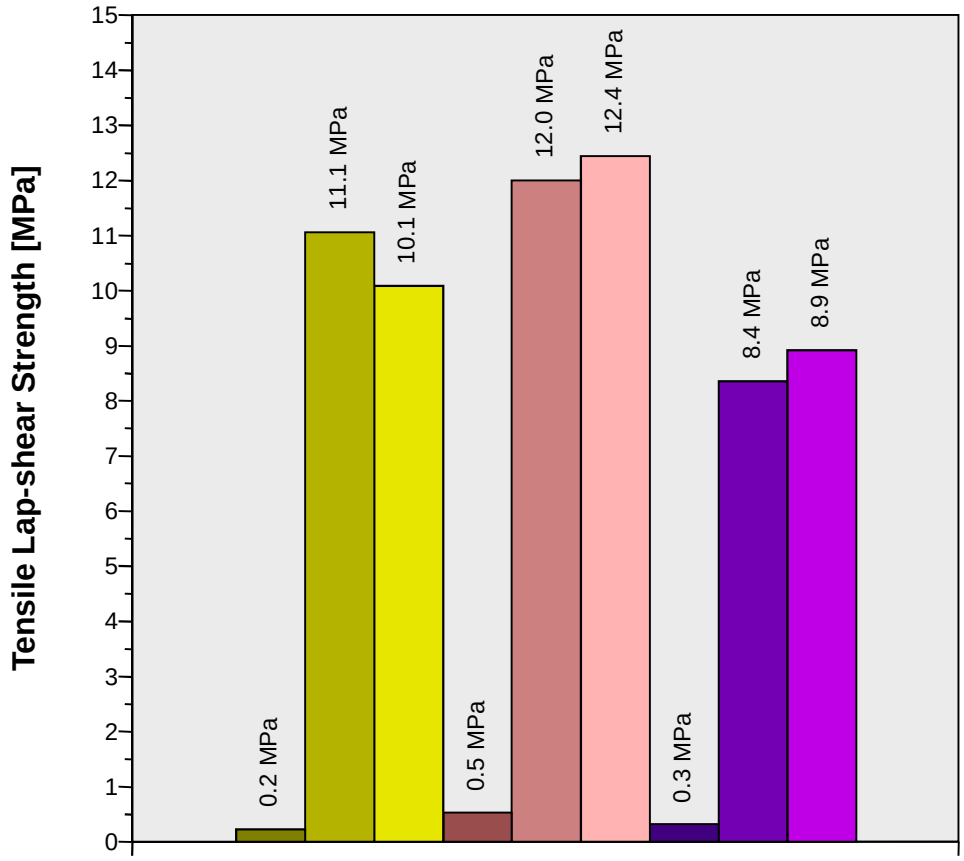
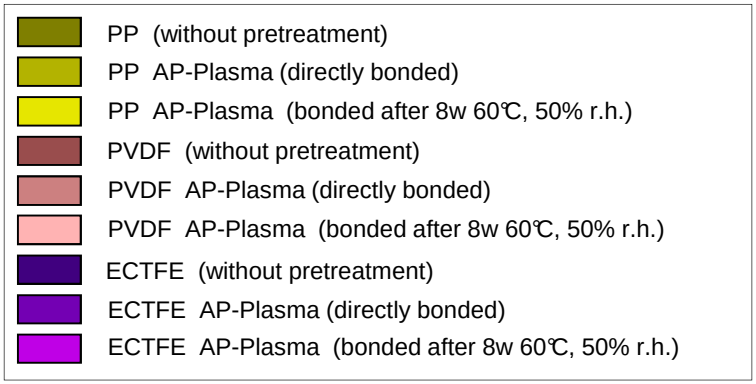
Tensile Lap-shear Strength of Plastic Bondings





2 K - epoxy system:
Ciba Araldit AW 139 / HV 998
Curing at 80 ℃, 2 h

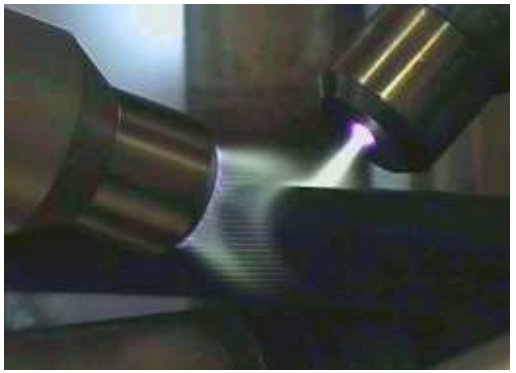
Fraunhofer IFAM Institut Fertigungstechnik Materialforschung

Openair®-Plasma Düsen

Plasma Jet PFW10

Treatment width: 3 – 20mm
Treatment speed: up to 900 m/min

Plasma Jet PFW20



Plasma Jet RD1004

Treatment width: 10 – 50 mm
Treatment speed: up to 30 m/min

Plasma Jet RD2004

Plasma Jet RD1010

Openair®-Plasma nozzle heads

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Precision Cleaning of metallic Surfaces

Materials: **Aluminum**
Steel

<u>Improvement of component advantages by specific modification of the surface:</u>

- good cleaning capacity compared to carbon hydrids (precision cleaning)

- modification of the surface for adhesion/paint bonding (adhesion characteristics)

- change of the corrosion characteristics (Hydrolysis stability)

- improvement of the weldability (disposal of „gas tanks“)

Coating with Openair Plasma

Precipitation of thin layers

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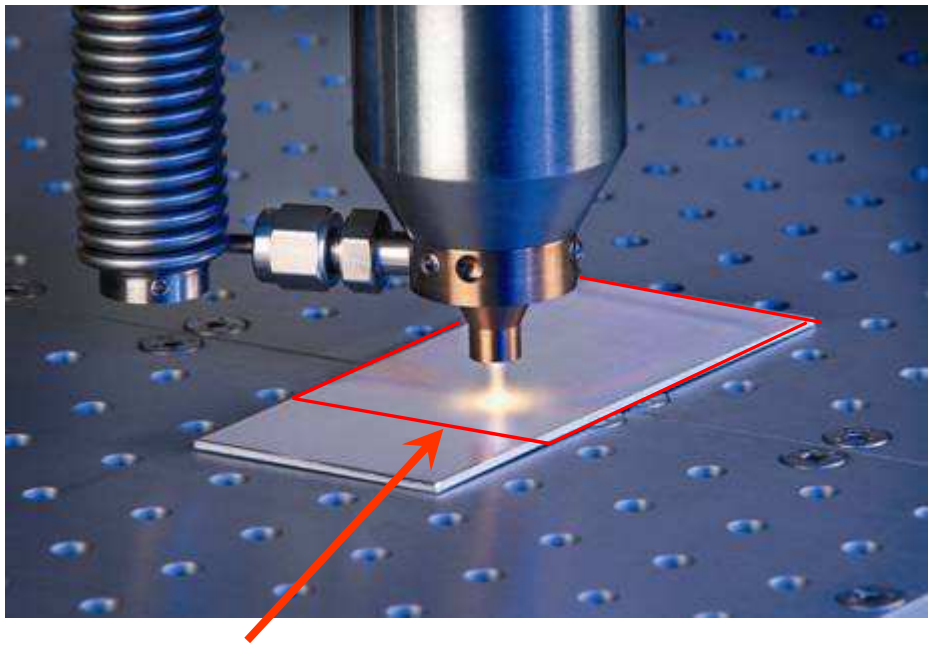


Openair®-Plasma coating

Coating on Aluminum with various layer thicknesses between 5 and 700 nm

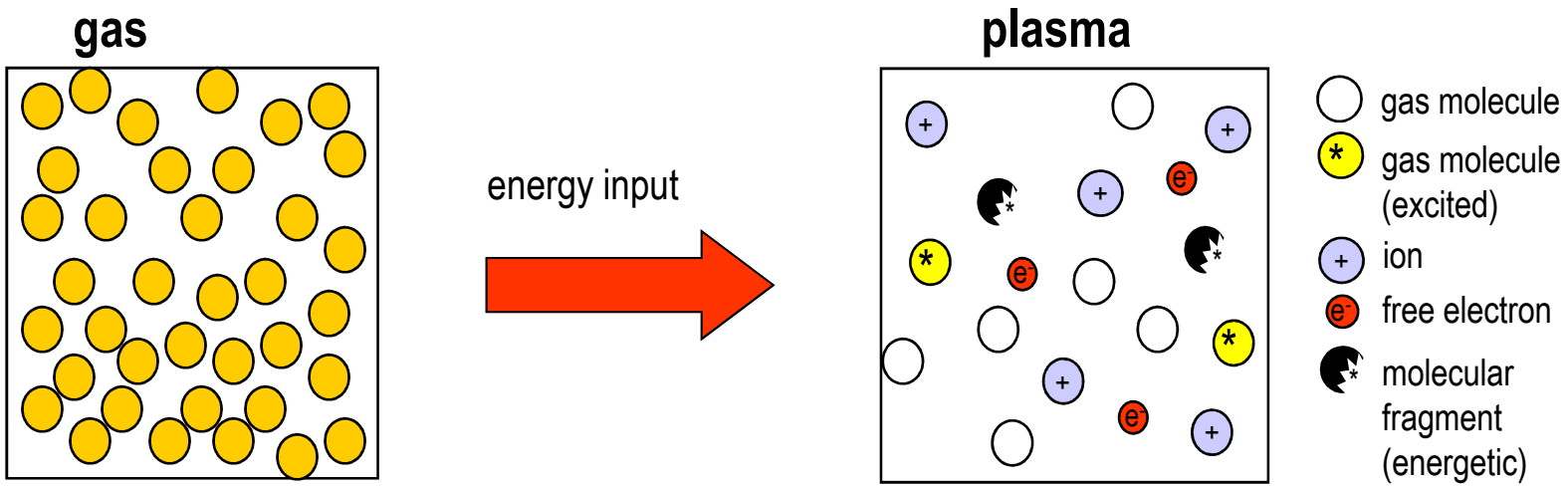
Functionalities:

- hydrophile
- hydrophobic
- Anti corrosion layers
- Adhesion promoter layers
- De-hesive coatings

Substrate:

- Metal
- Plastics
- Glass

Basics - Plasma



Example:

CH_4 molecules

$CH_4^{*,+,-}$, $CH_3^{*,+,-}$, $H_x^{*,+,-}$, $C_xH_y^{*,+,-}$

H_2, C_xH_y

plasma polymerisation

Quelle: Fraunhofer IFAM

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Application of Plasmapolymere Layers

- **Adhesion promoter layers**
  for reactive glues (PUR, Epoxy, Compounds)

- ***Anti-Corrosion layers***
  for Aluminum, Steel

- ***„easy to clean“ coating***
  Metals

- ***Scratch resistant layers***
  e.g. for Polycarbonate (mobile-phone displays)

- ***Barrier layers***

PT- Bond technology

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Corrosion protection on Aluminum; PT-Corr technology

Salt spray test 96 h (DIN 50021)

- The corrosion behavior of aluminum pipes with and without coating was tested
- after 96 hours salt spray test, the **untreated aluminum shows strong corrosion**
- On the **coated material** there occurred **no corrosion**

PlasmaPlus®- Coating technology

Corrosion protection Motor- Pump- Unit

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Corrosion protection and Adhesion promotion on milled Aluminum pressure housings

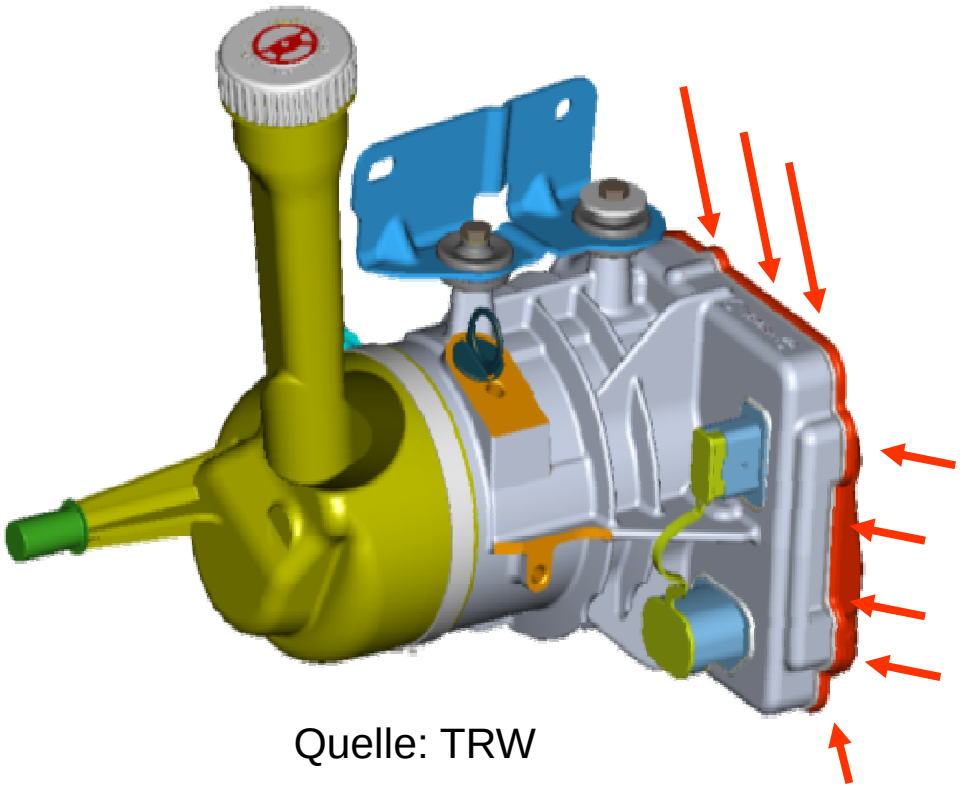
Avoidance of the corrosive corrosion creep of the glue bonding

Original Process

- Spraying on of a corrosion protection remedy based on Fluorpolymere after bonding
- Manual application, high cost

Today

- Pre-cleaning with Plasma
- Coating with Si-organic layer
- Good bonding



Quelle: TRW

PlasmaPlus®- Coating technology

Corrosion protection Motor- Pump- Unit

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Density inspection after Salt spray test (Swaat-Test)

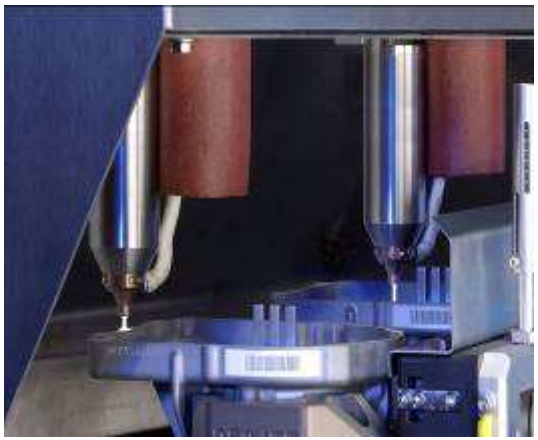
h

	50	250	500	750
Without corrosion protection	i.O.	n.i.O.	n.i.O.	n.i.O.
„Sprayed“ corrosion protection	i.O.	i.O.	i.O.	n.i.O.
Plasma Plus® corrosion protection	i.O.	i.O.	i.O.	i.O.

green: Housing shows no leakage

red: Housing is leaky (corrosion on the flange with aperture towards inside)

Highly efficient anti corrosion coating



PlasmaPlus®- coating technology

Corrosion protection Motor- Pump- Unit , systems engineering

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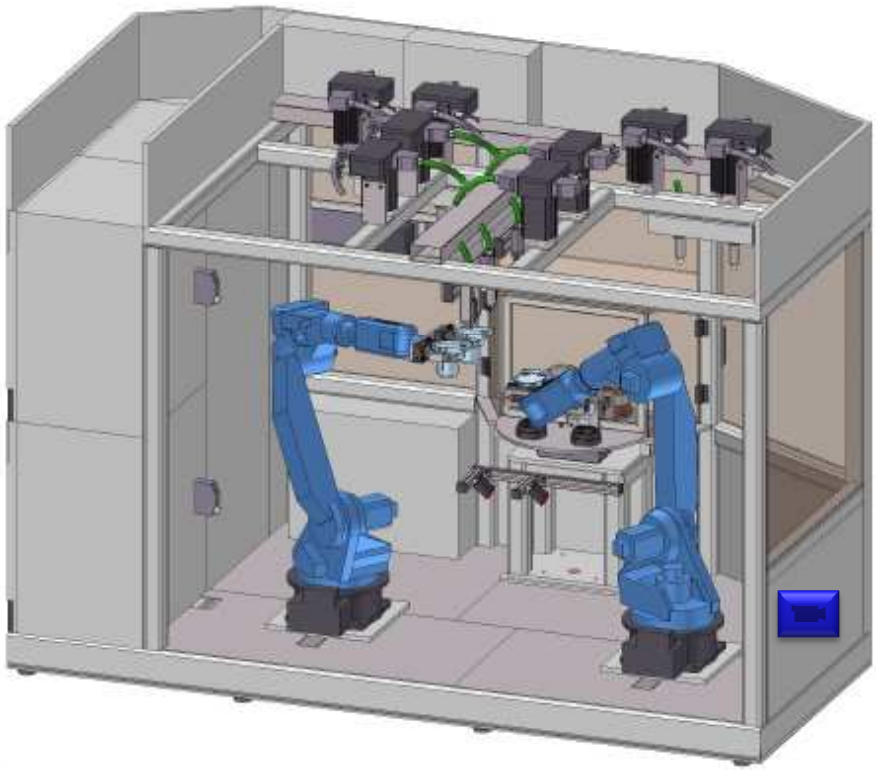

- **completely automated in a double- Robot cell**
- **throughput 1,2 Mio. part p.a.**
- **comprehensive process control of the PlasmaPlus® - coating enables high process safety (Safety part of the steering)**

FPC - FinePowederCoating

Bildquelle: Plasmatreat/efc plasma

Bildquelle: Plasmatreat/efc plasma

- FPC- System Technology
  - Development
  - Production
  - Sales and Service world wide

Bildquelle: efc plasma

- FPC – Process Technology
  - R&D for layer functionallities
  - powder management
  - powder feeder
  - process parameters

FPC - FinePowederCoating

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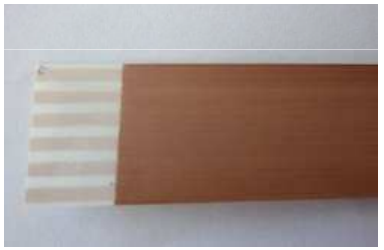
application	layer thickness	substrate temperature	coating powder
PVD	1 – 10 µm	200 – 500 °C	hard material
CVD	1 – 50 µm	400 - 2.000 °C	SiC, GaN, Ag, polycrist. diamond, Korund
FPC-Coating	1 – 200 µm	10 – 100 °C	metal powder, semiconductor, polymeres
thermal spraying	40 – 3.000 µm	300 – 750 °C	Fe and non-Fe-metals, carbides, ceramics

Bildquelle: efc plasma

Vakuum-system

Vakuum-system



FPC - FinePowederCoating

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engineered functional coatings made by efc plasma technology open possibilities in new APPLICATIONS and PROCESSES regarding

plasma GRIPefc

TRIBOLOGY

Bildquelle: efc plasma

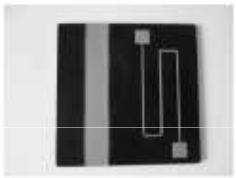
plasma CORRefc

CORROSION RESISTANCE

Bildquelle: efc plasma

plasma CONDUCTefc

CONDUCTIVITY



Bildquelle: efc plasma

plasma BRAZEefc

SOLDERABILITY

Bildquelle: efc plasma

plasma COOLefc

HEAT TRANSMISSION

Bildquelle: efc plasma

Summary

Openair® Plasma:

- **suitable for inline processes, capable for robots**
- **long-term stable activation of different plastics and metals**
- **precision cleaning of metallic surfaces on highest level**
- **Special technology: „ functional plasmapolymere layers“**
  - **inorganic and organic**
  - **hydrophilic and hydrophobic**
  - **corrosion protection**
- **FPC technology , coating with fine powder**

Thank you very much for your attention !

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Düsenköpfe PFW10/20