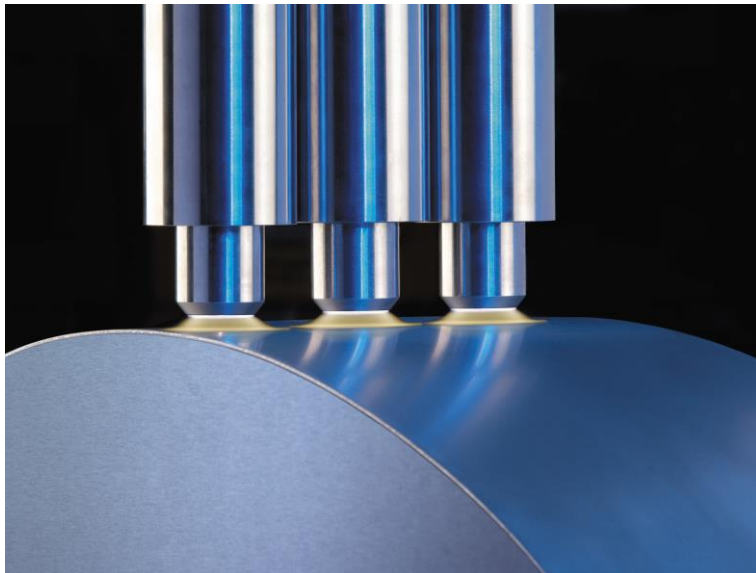
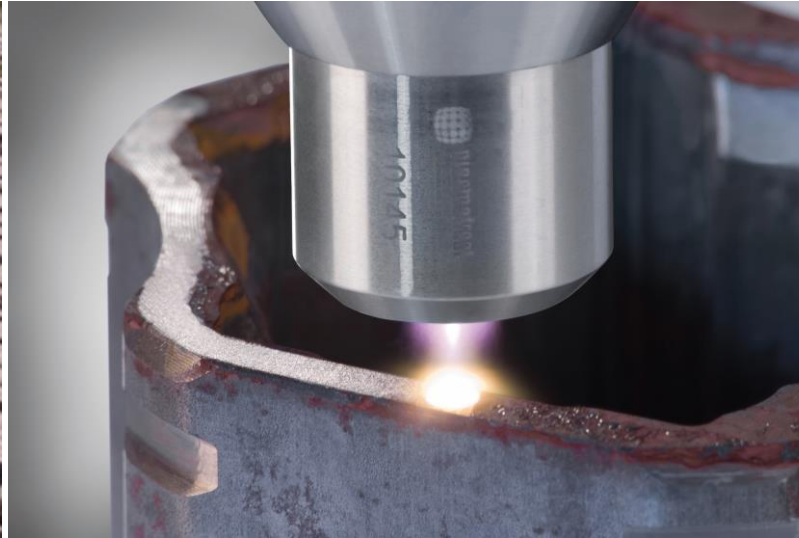


April 12, 2023

Spring 2023 Toxics Use Reduction (TUR) Conference



Openair-Plasma® is a Green Alternative to Traditional Cleaning Methods



- Surface Cleaning & Preparation via Openair Plasma
- What is Openair Plasma
- How is Openair Plasma Used
- How are the Effects of Openair Plasma Measured
- Application Examples

Market leader in Openair-Plasma® technology



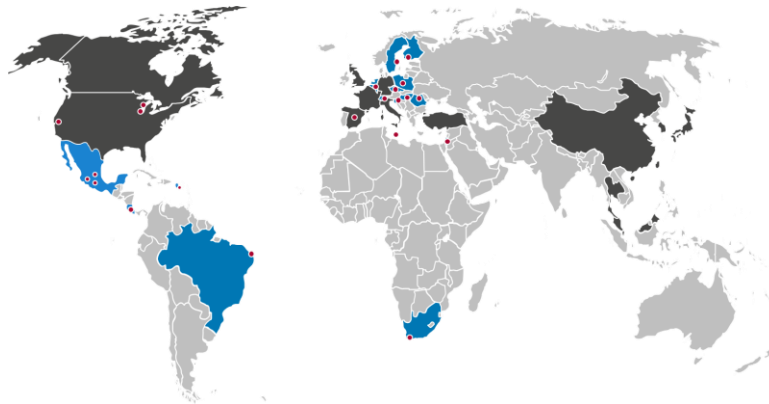
Global Presence

- HQ in Germany
- Production sites in Germany, China & USA
- 17 Subsidiaries & Technology Centers in 11 Countries
- 15+ agents in ROW



Family Owned Business

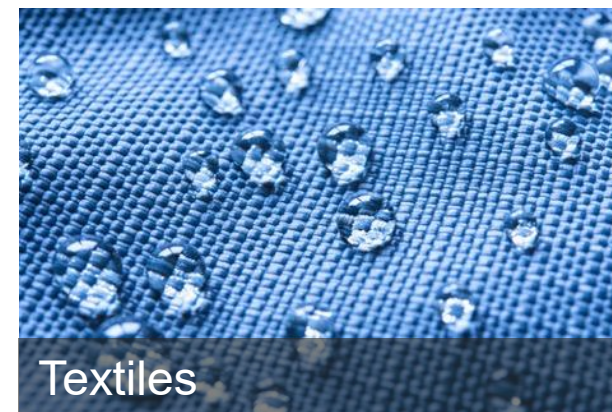
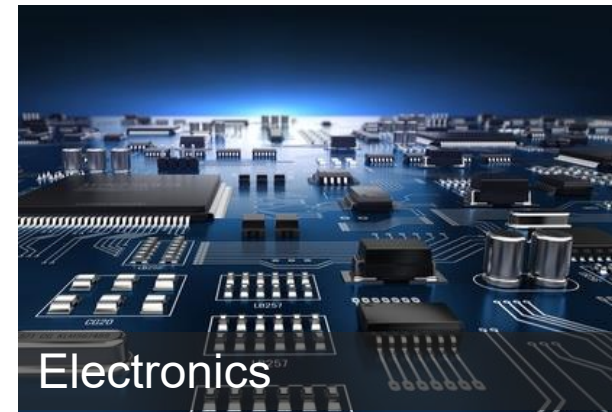
- Founded in 1995
- 250 employees worldwide
- Consolidated turnover: \$53 Million



Milestones

1995: Invention of Openair-Plasma®
2007: PlasmaPlus® coating
2019: Opening of the HQ Technology Center

Industry Solutions



What is Plasma?



SOLID



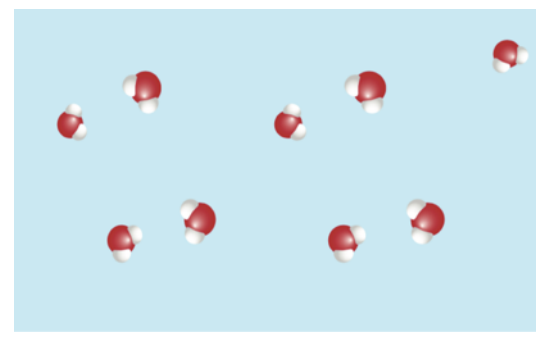
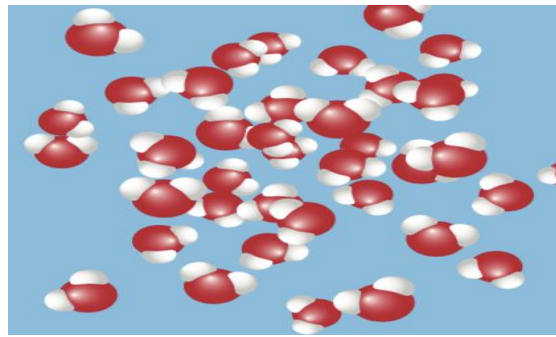
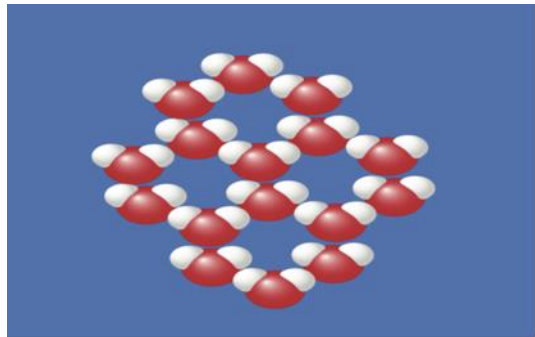
LIQUID







GAS

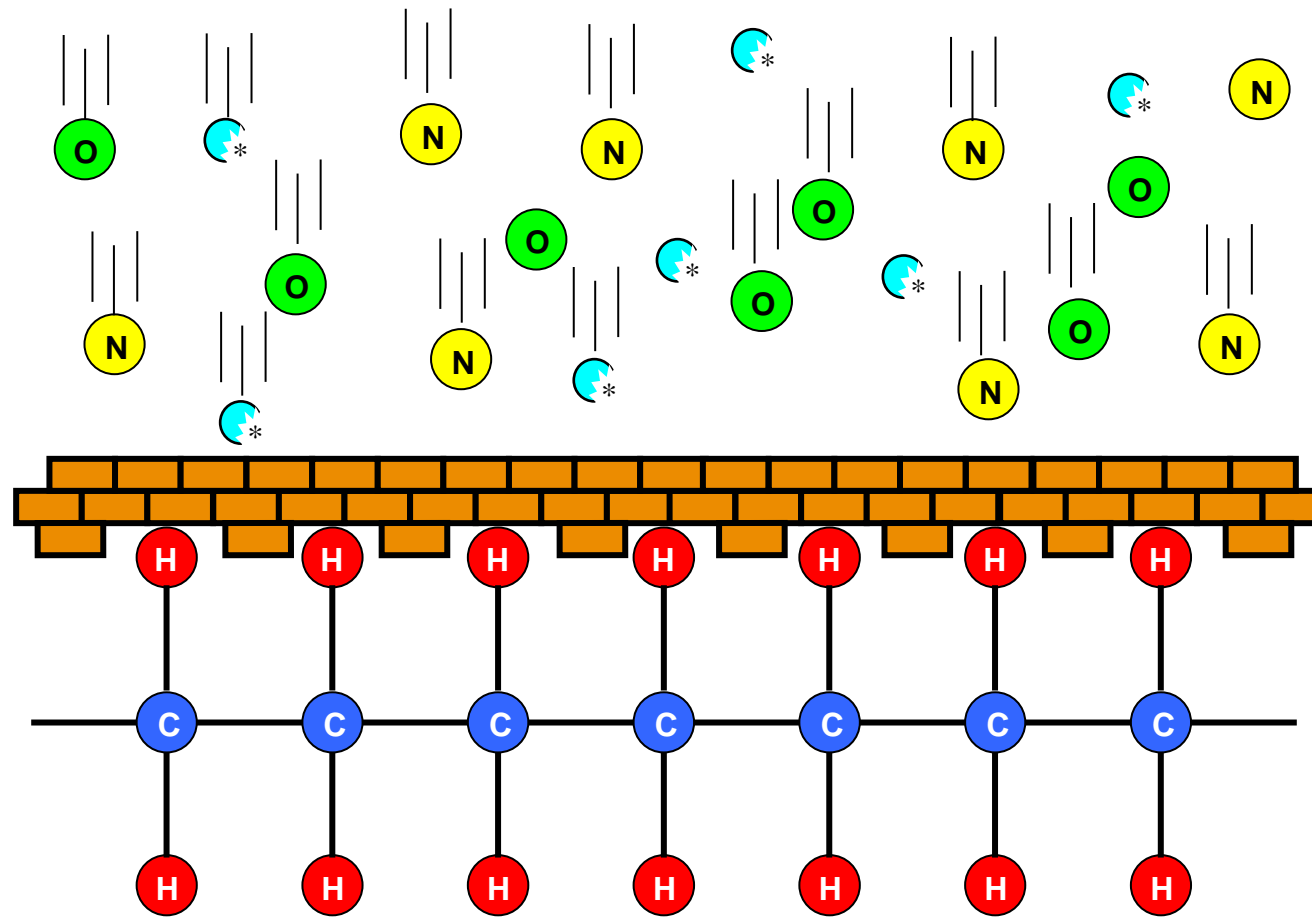


PLASMA

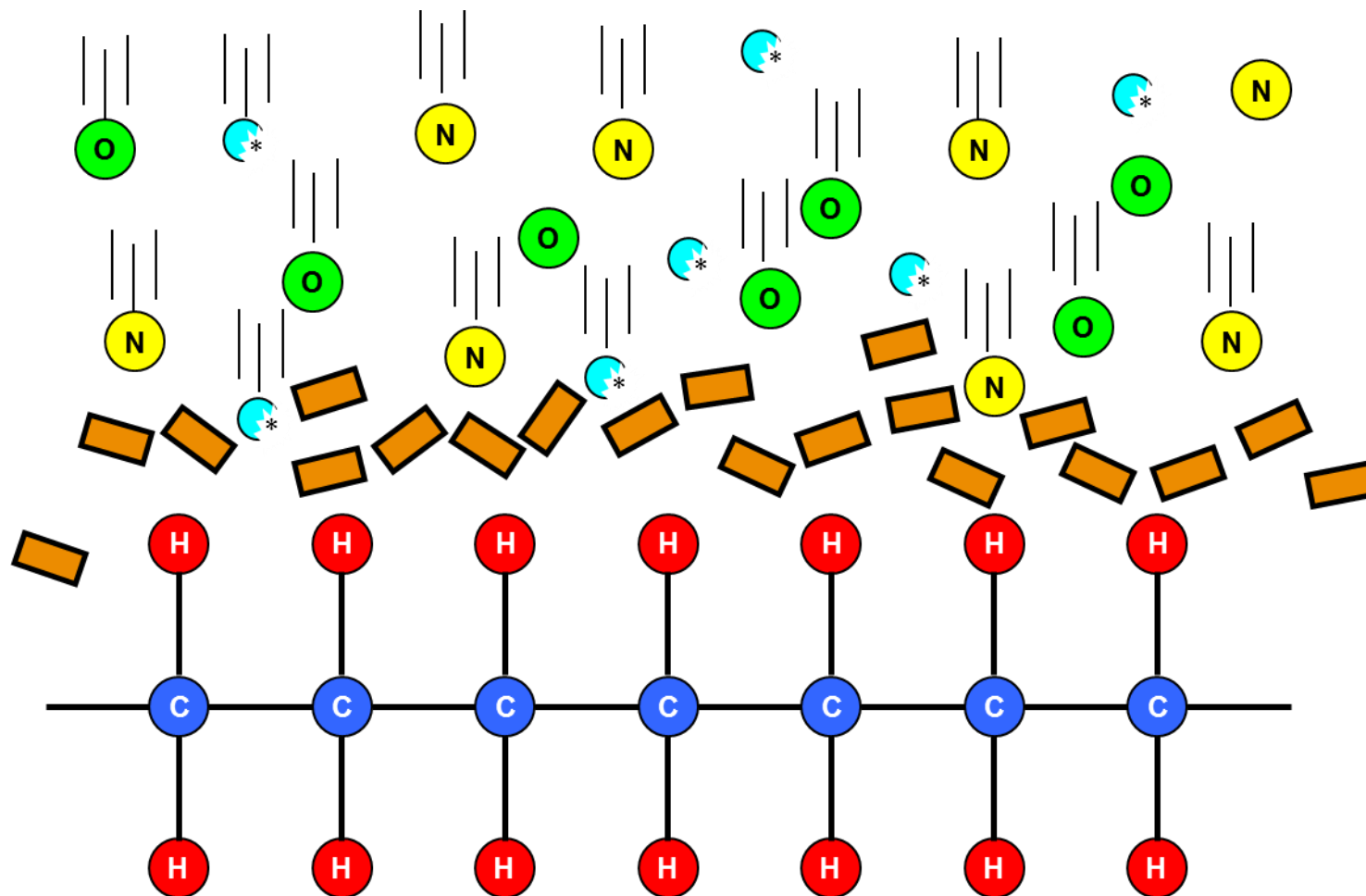


-  Excited Gas-molecules
-  Ions
-  Free electrons
-  Excited molecule-fragments

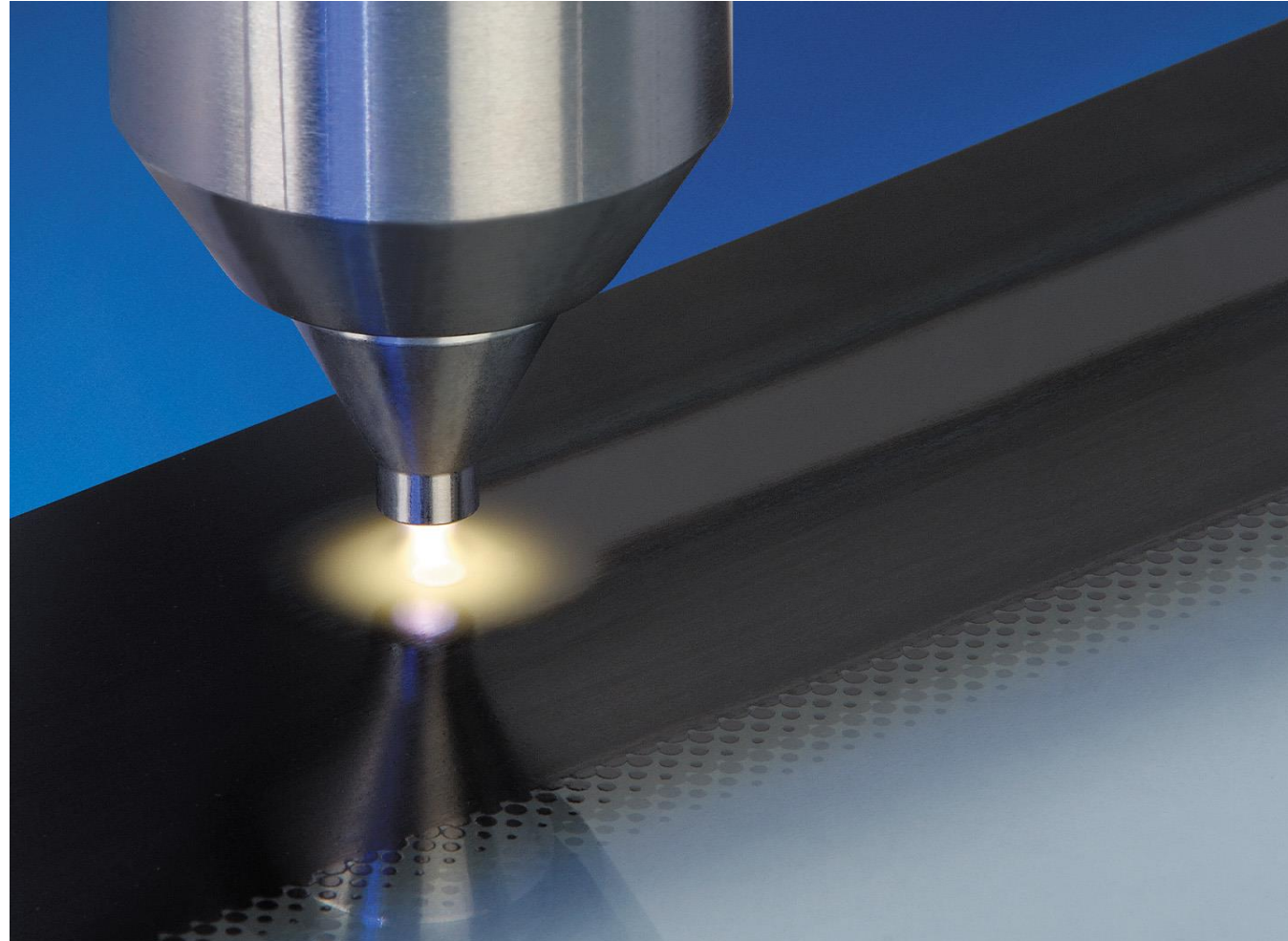
Attack Surface Contamination



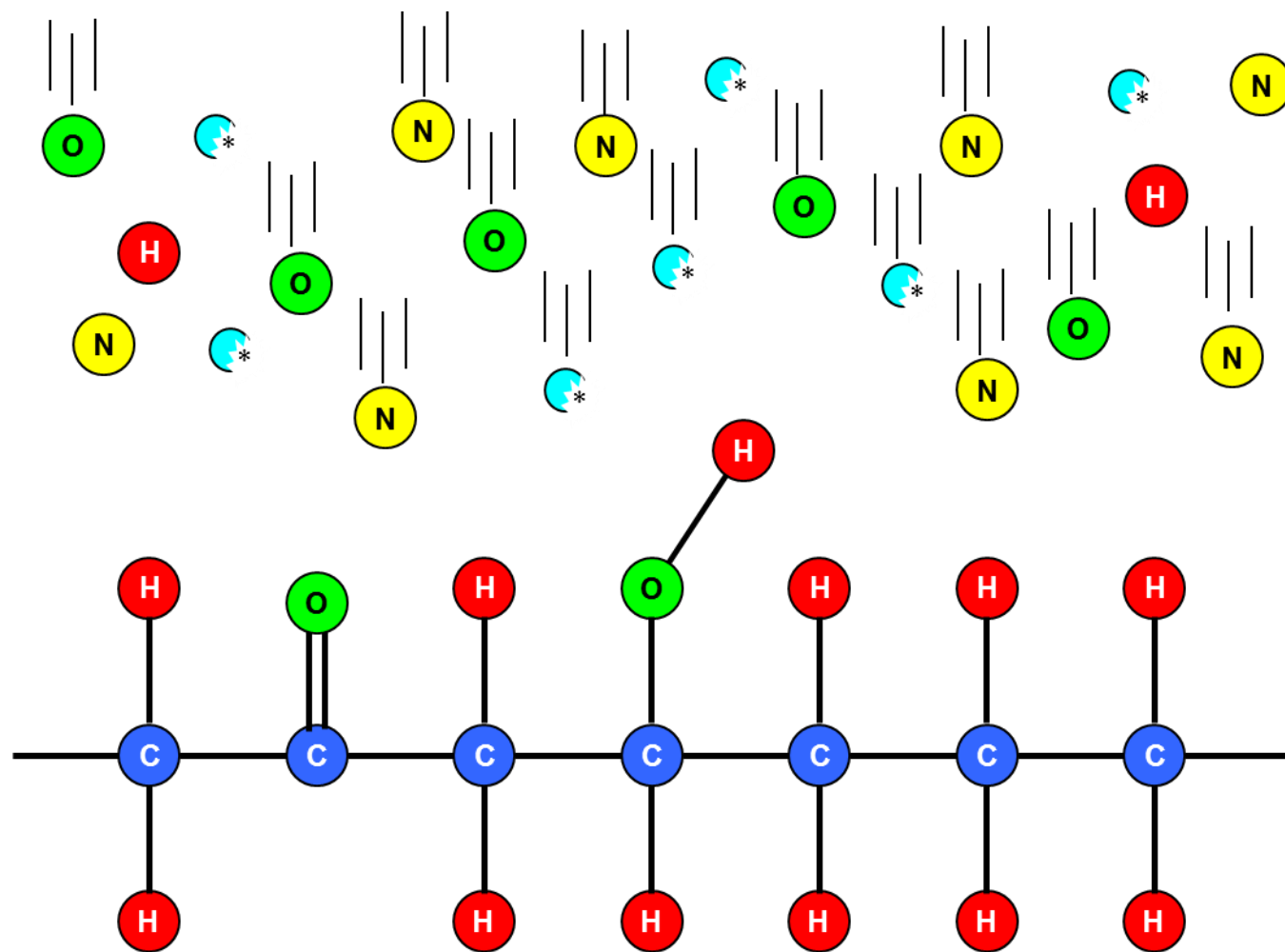
Remove Contamination



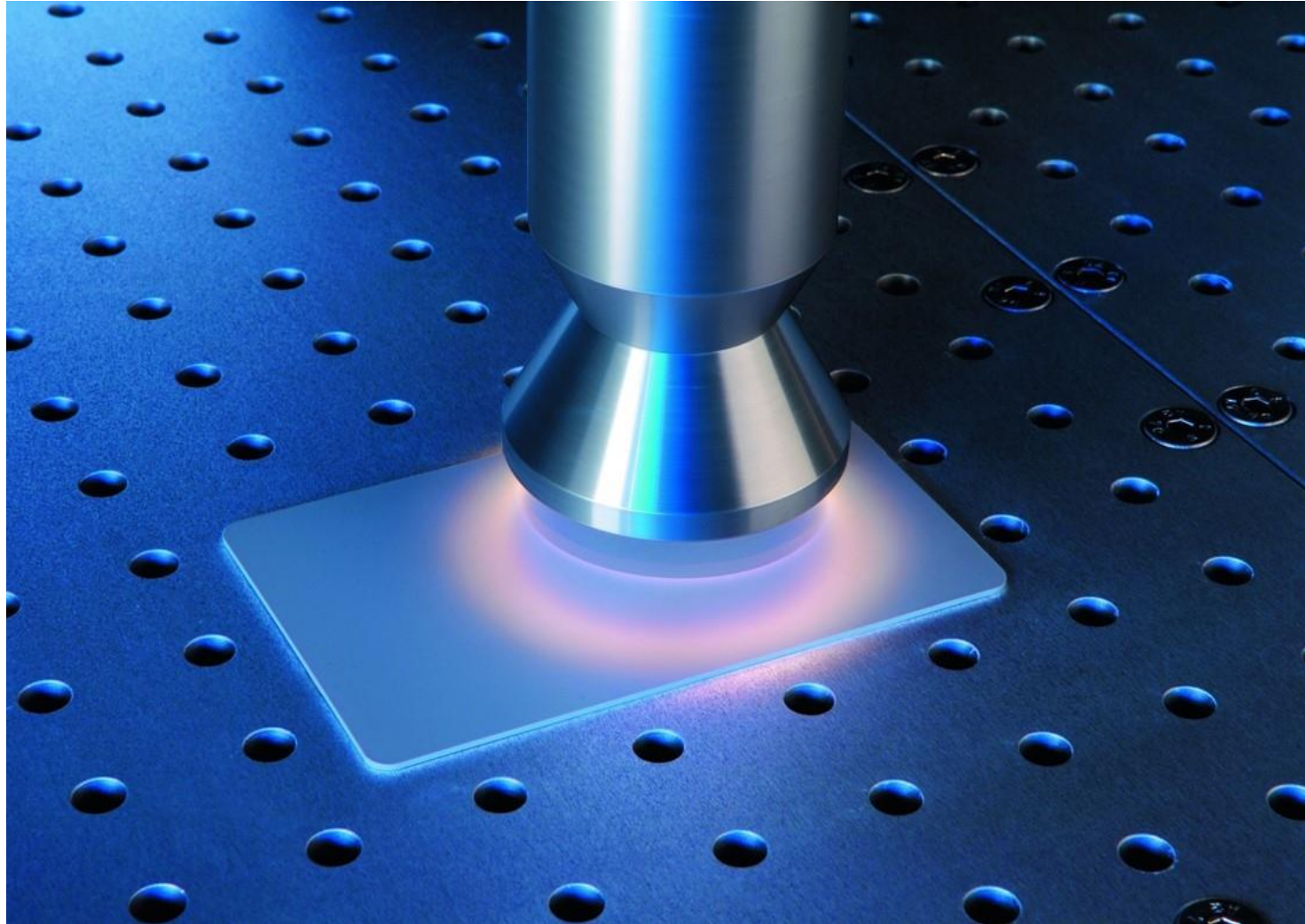
Openair-Plasma[®]: Cleaning



Form Functional Sites

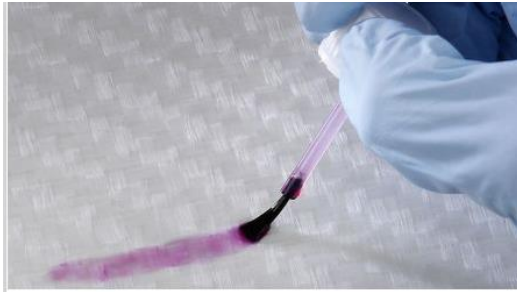


Openair-Plasma[®]: Activation

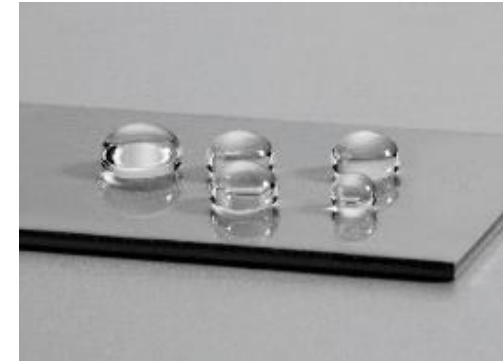


Measurement of the result

Verify by test ink



Wettability of the surface

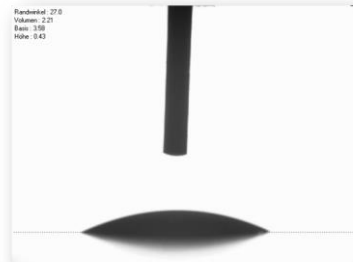


Initial state

Measurement of contact angle



**Big contact angle
low surface energy**

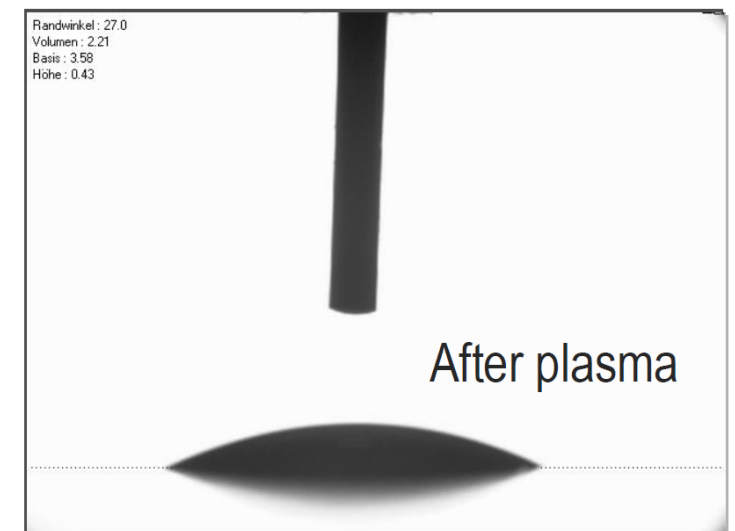
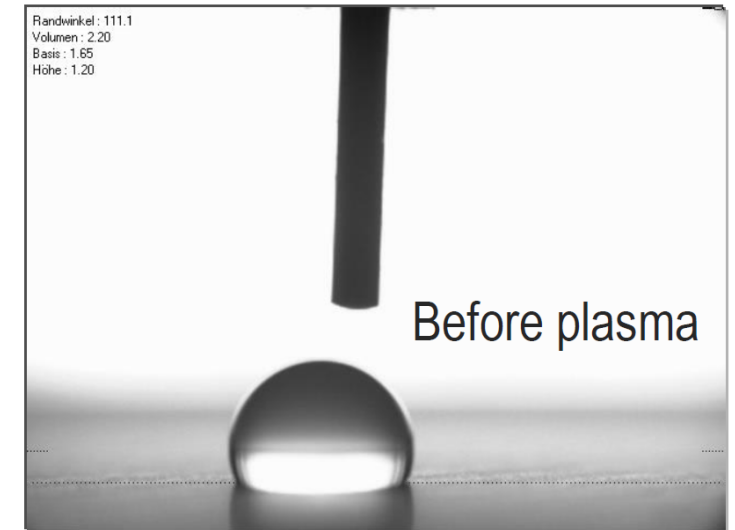
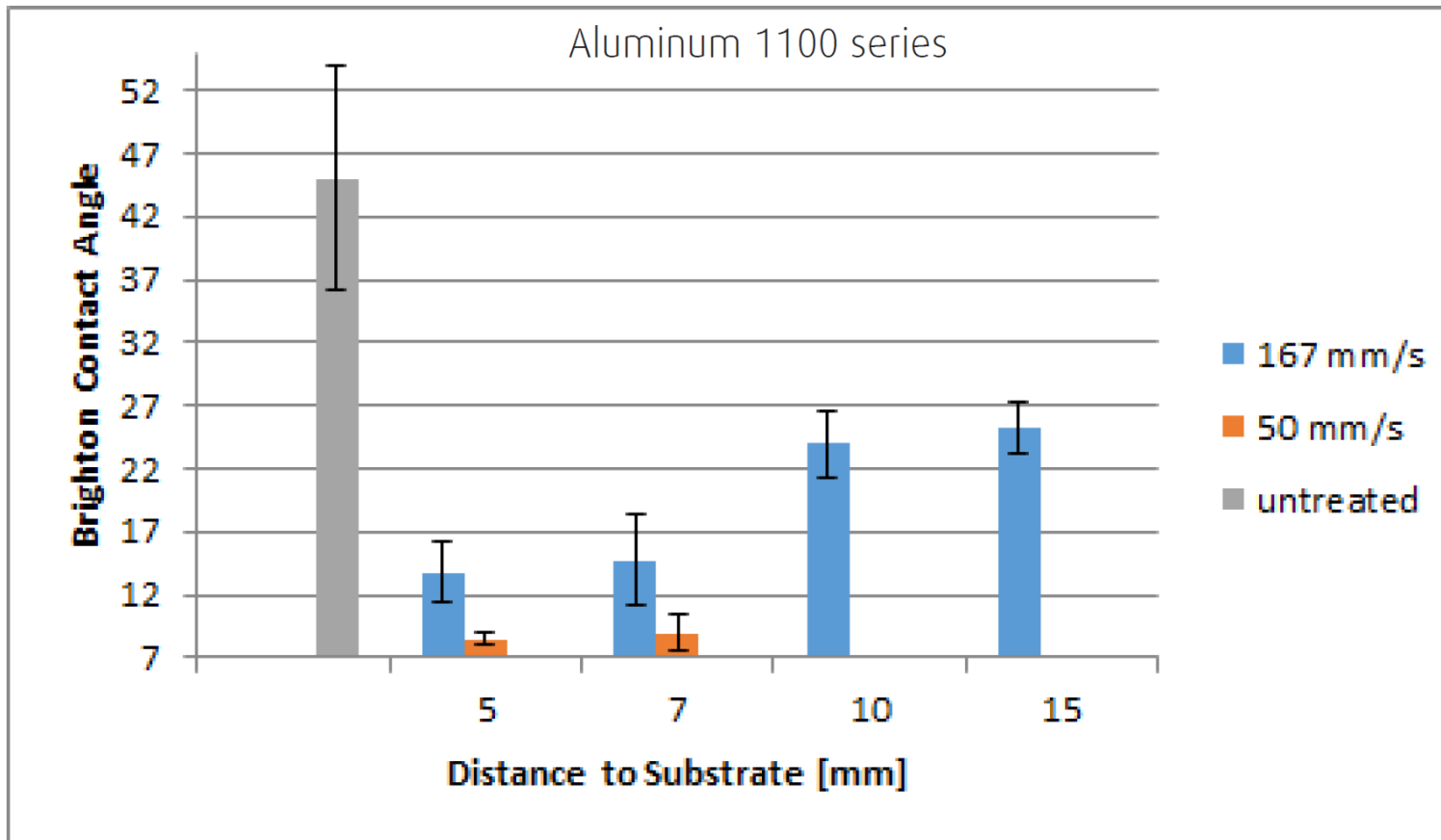


**Low contact angle
high surface energy**

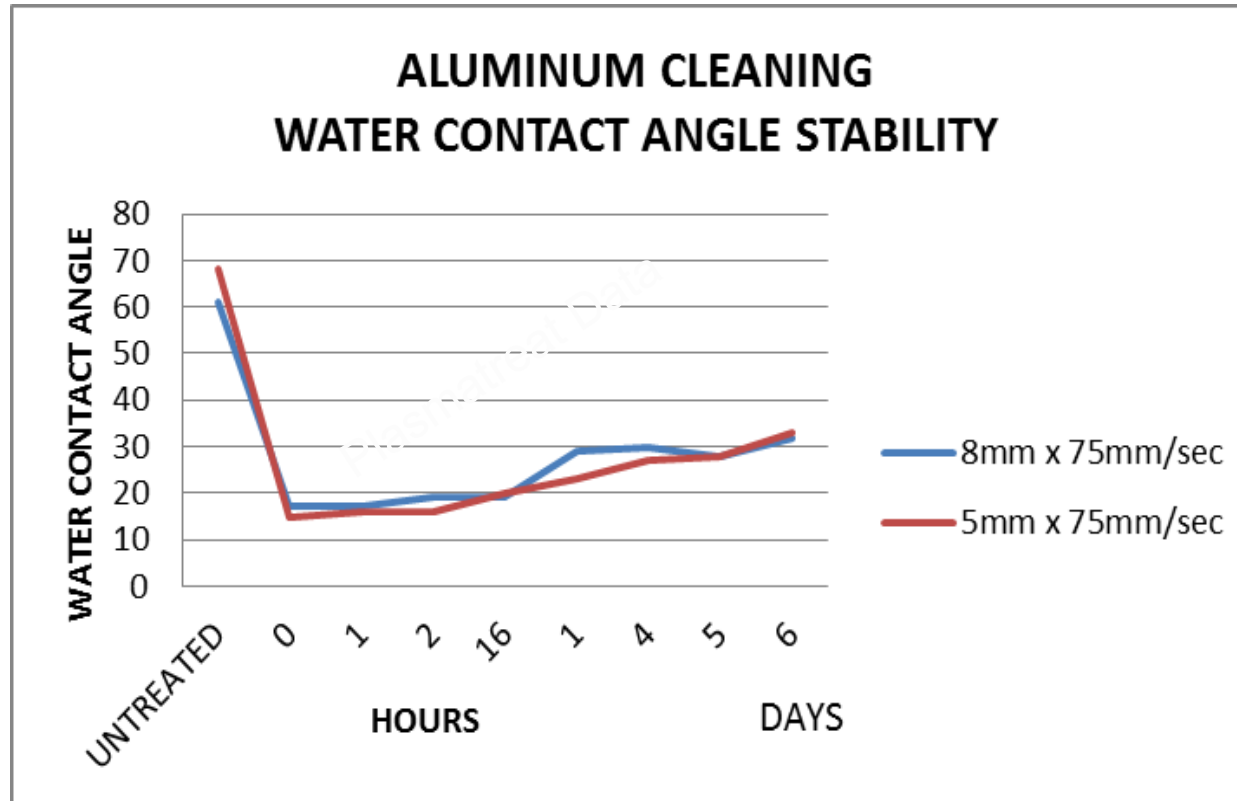


After treatment

Water Contact Angle



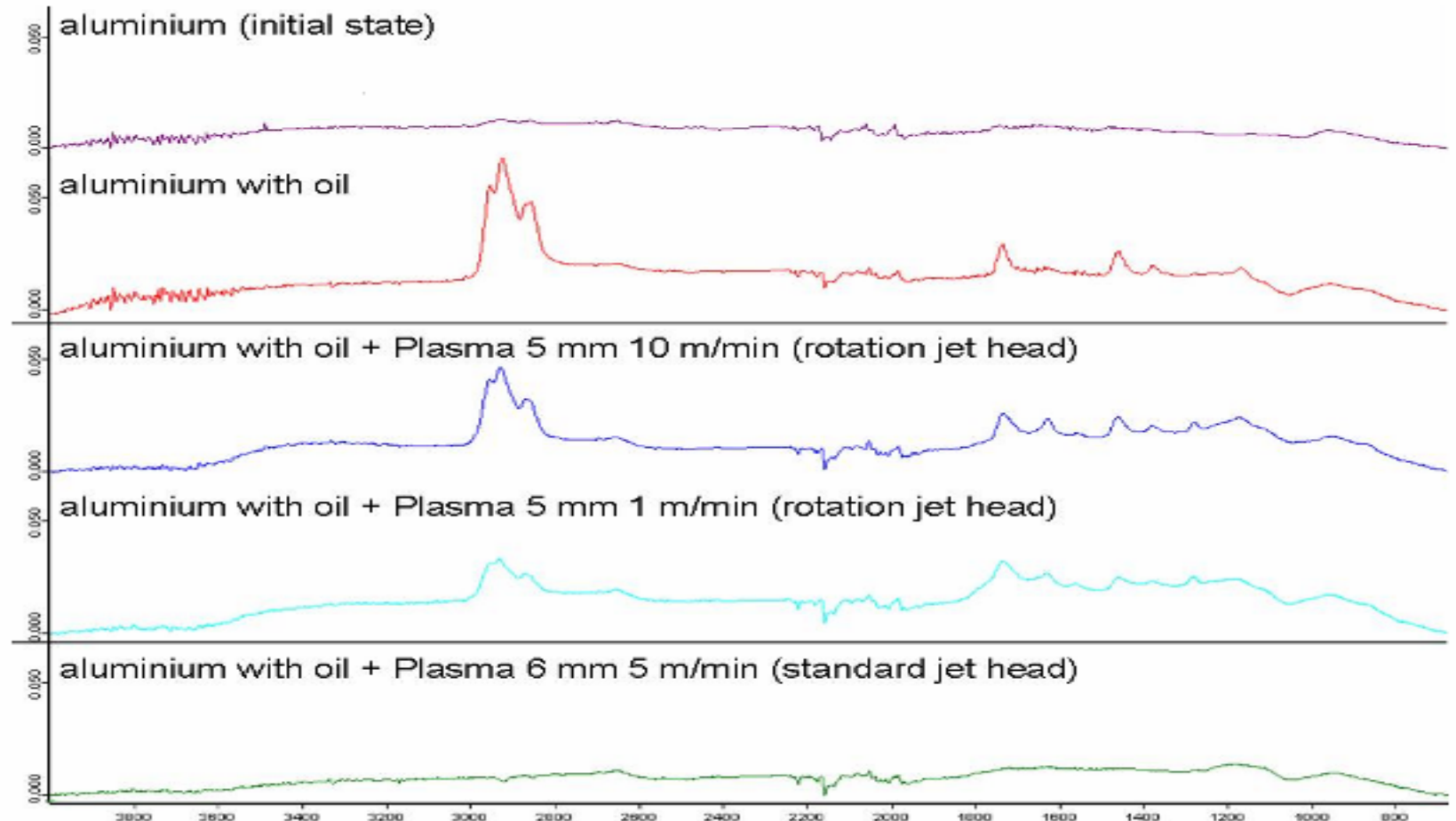
Surface Stability by Water Contact Angle



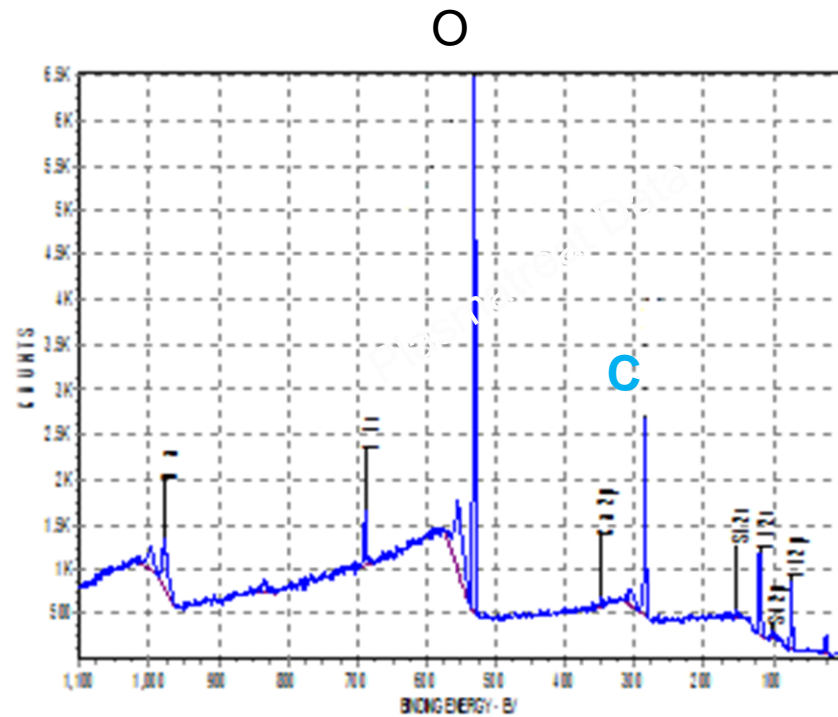
Surface Analyst
brighton
TECHNOLOGIES GROUP, INC.

IR-Spectroscopy (ATR)

- Oil-contaminated aluminum sheets were cleaned with plasma
- Removal of the oil on the surface is varying for the different jet head types
- Rotation jet head cleans a wider surface area (less intensively)
- Standard jet head can operate at higher speed and more gap to remove the oil completely

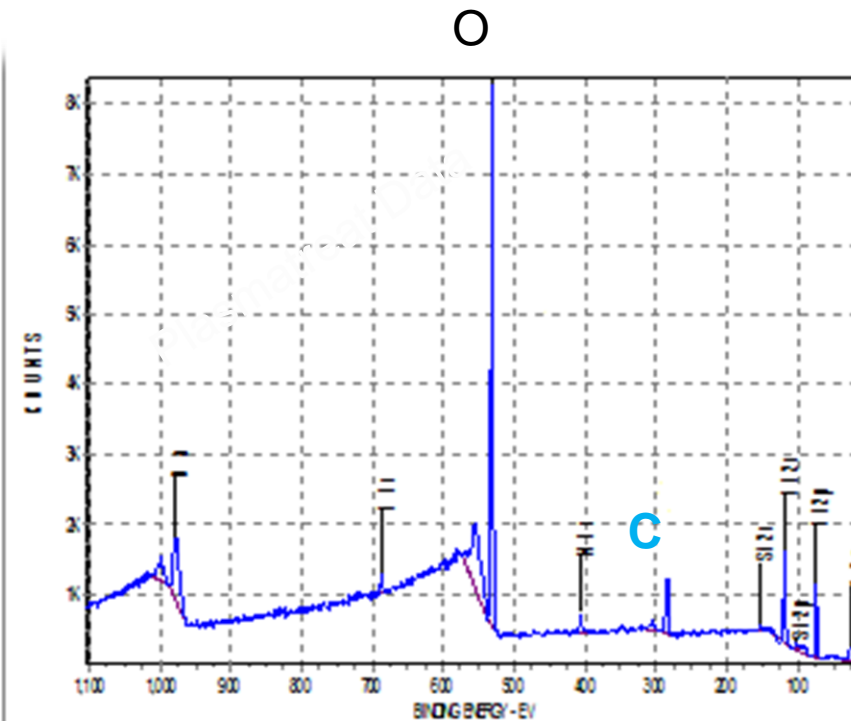


X-Ray Photoelectron Spectroscopy (XPS)



Aluminum control

XPS Line	Atom %
F 1s	3.304
O 1s	39.707
C 1s	36.889
Al 2p	17.523
Si 2p	2.099



Aluminum post plasma

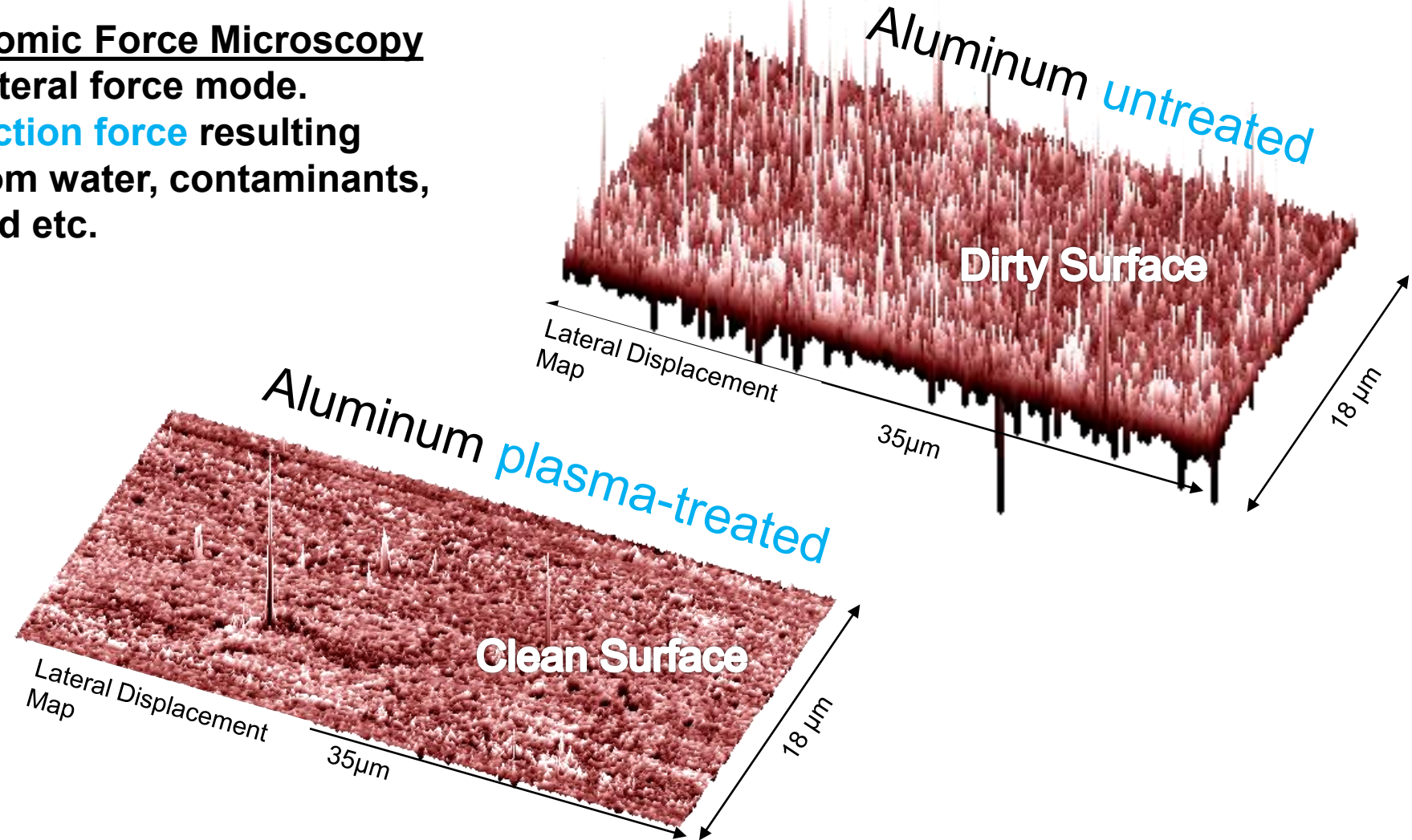
XPS Line	Atom %
F 1s	1.904
O 1s	52.431
C 1s	15.617
Al 2p	26.309
Si 2p	1.198

Lateral Force Measurement - AFM

Atomic Force Microscopy

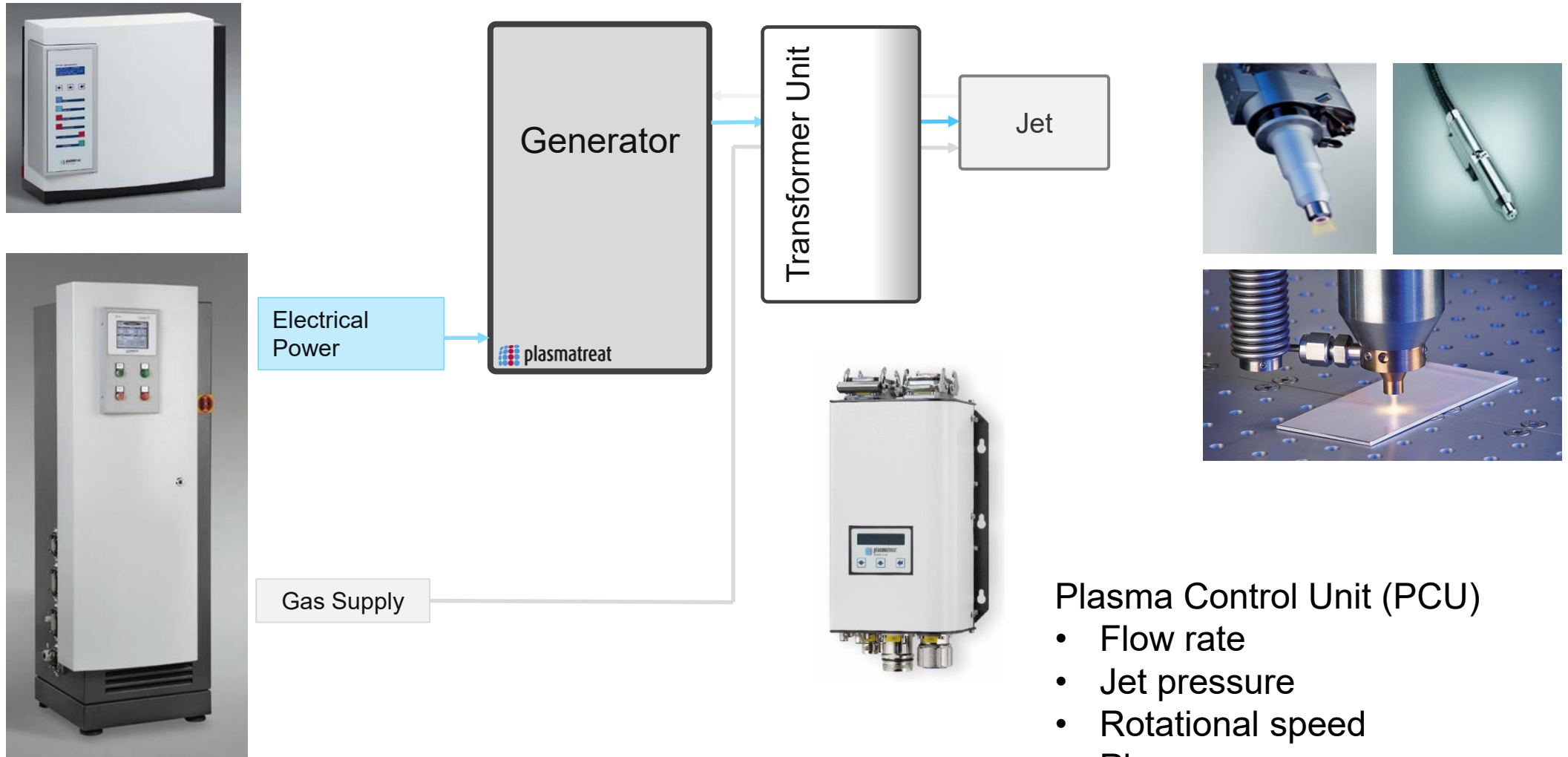
Lateral force mode.

friction force resulting
from water, contaminants,
and etc.

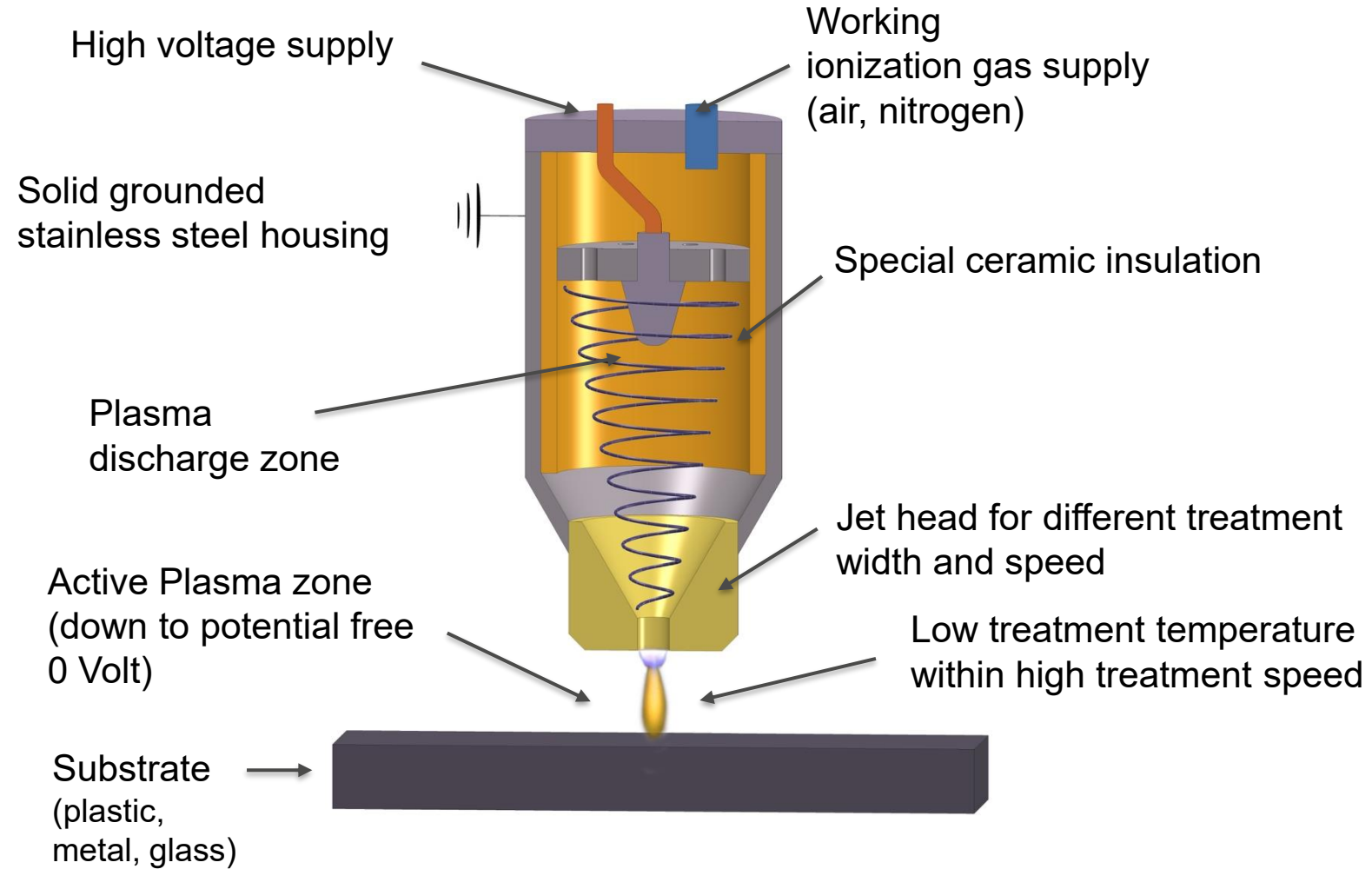


Source: Institute Nanocraft
By order of: Co. Griesser

Openair® Plasma Systems Configurations – Basic Structure

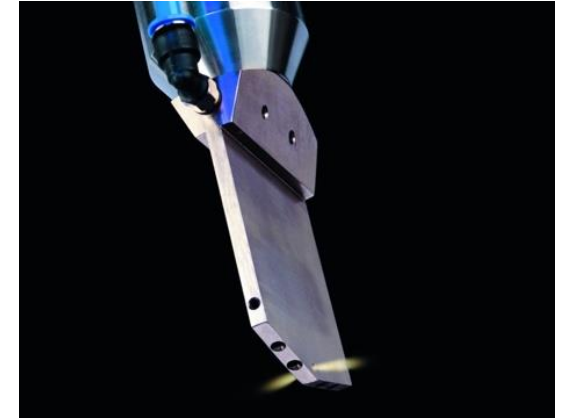
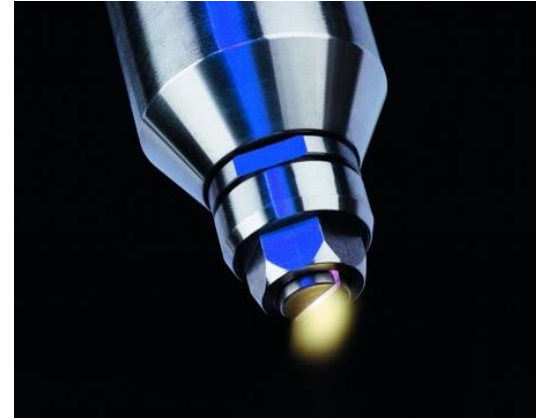
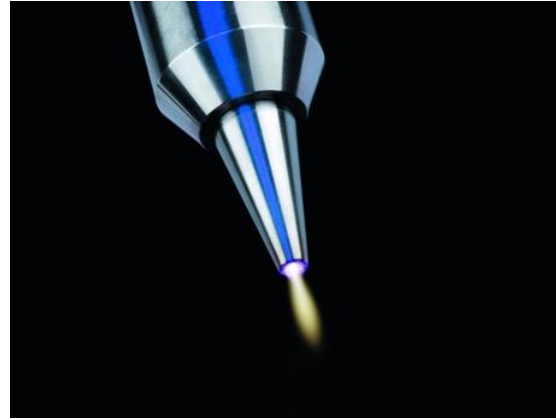
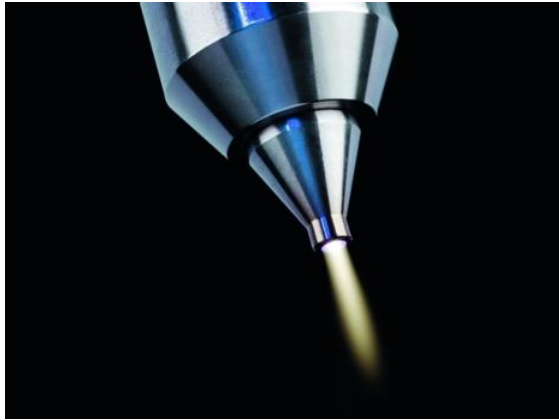


Openair-Plasma[®] Technology

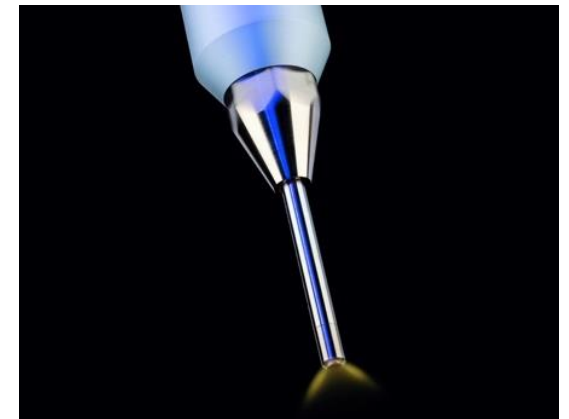
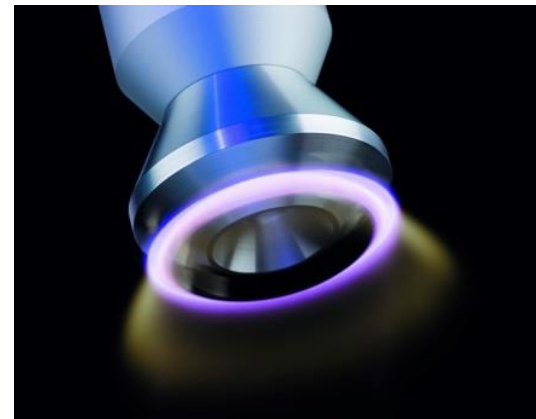
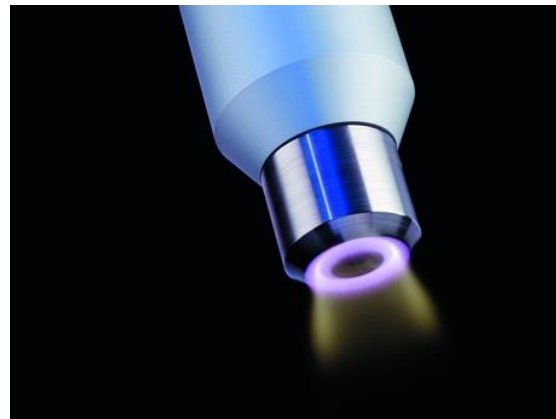


Openair-Plasma® Jet Technology

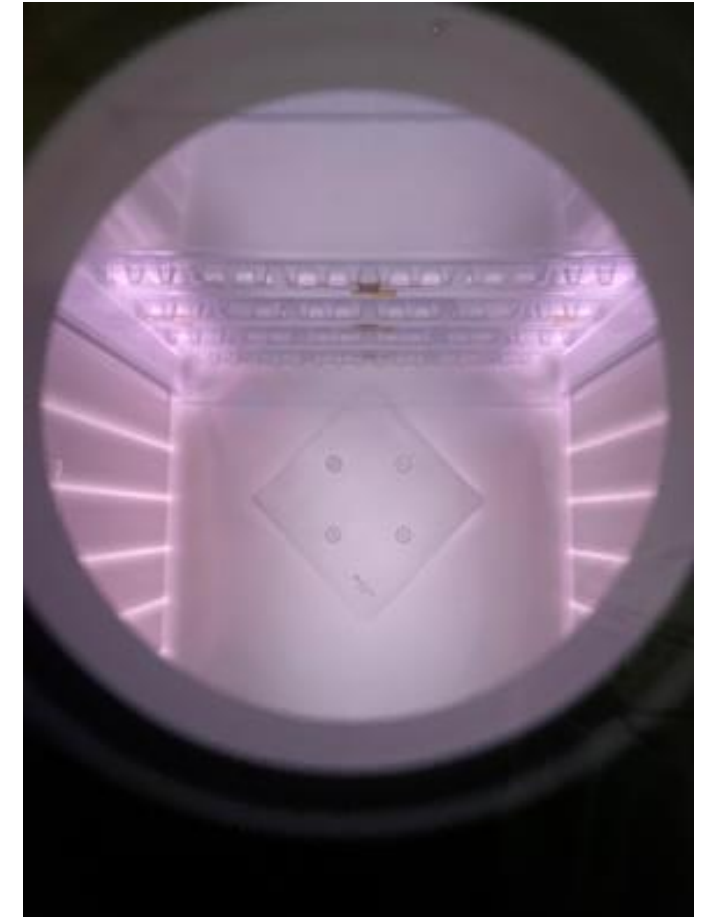
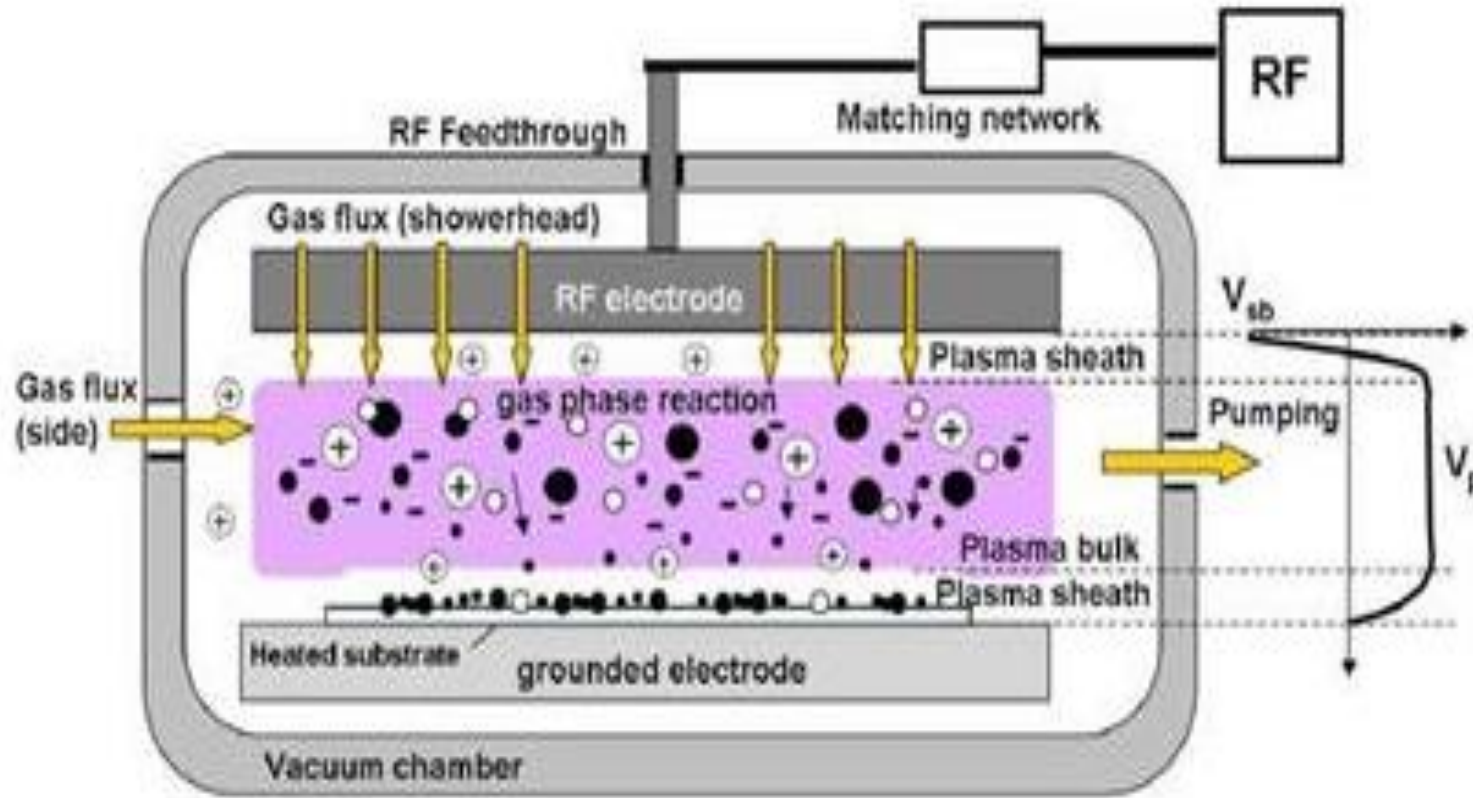
Static jets:



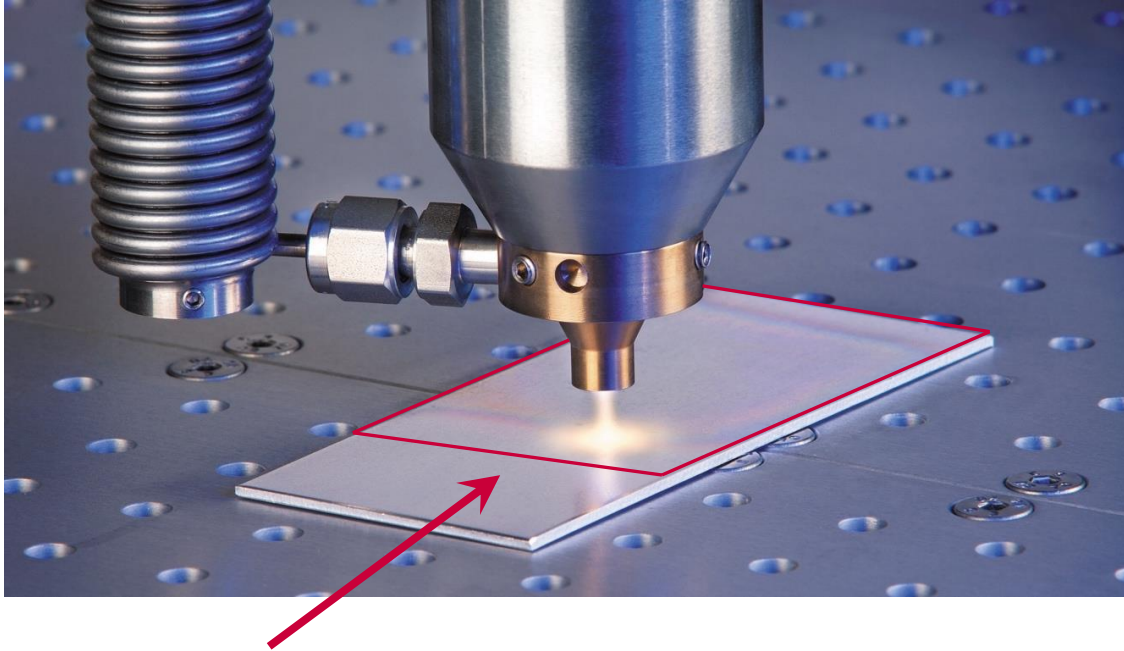
Rotary jets:



RF Batch Plasma



Openair-Plasma[®]: Nano - Coating



Openair-Plasma[®]- Coating

Coating deposited on aluminum with varying thickness between 10 - 700 nm

Possible Functionalities:

- hydrophilic
- hydrophobic

Substrates:

- metal
- polymer
- glass

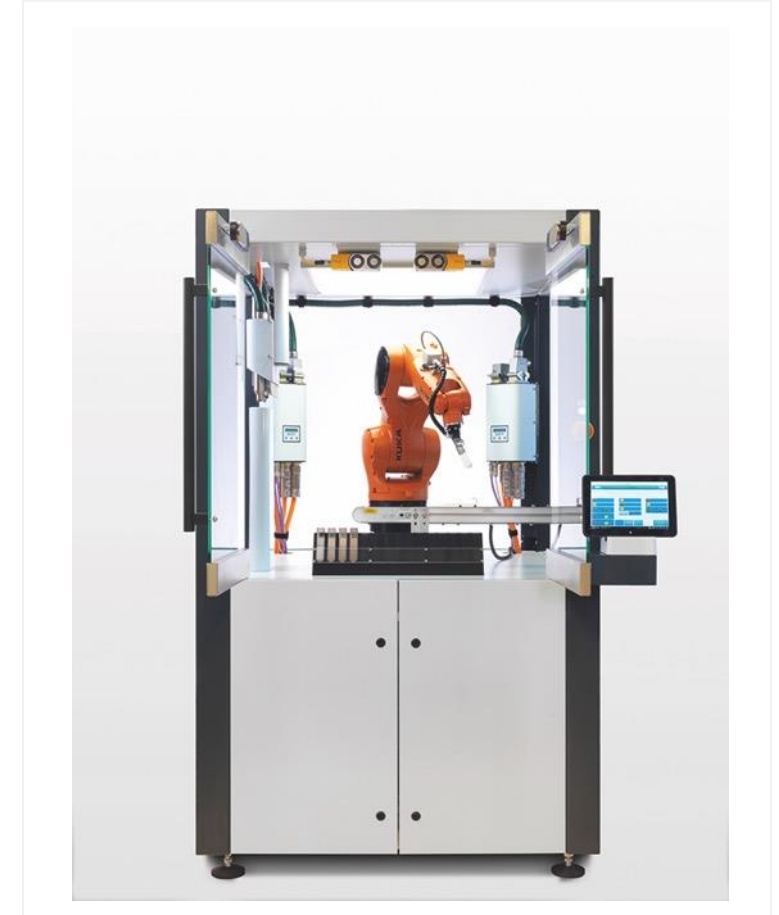
Standard Components



Standard Configurations



Customized Systems



Openair-Plasma® Cell for PCB Assembly

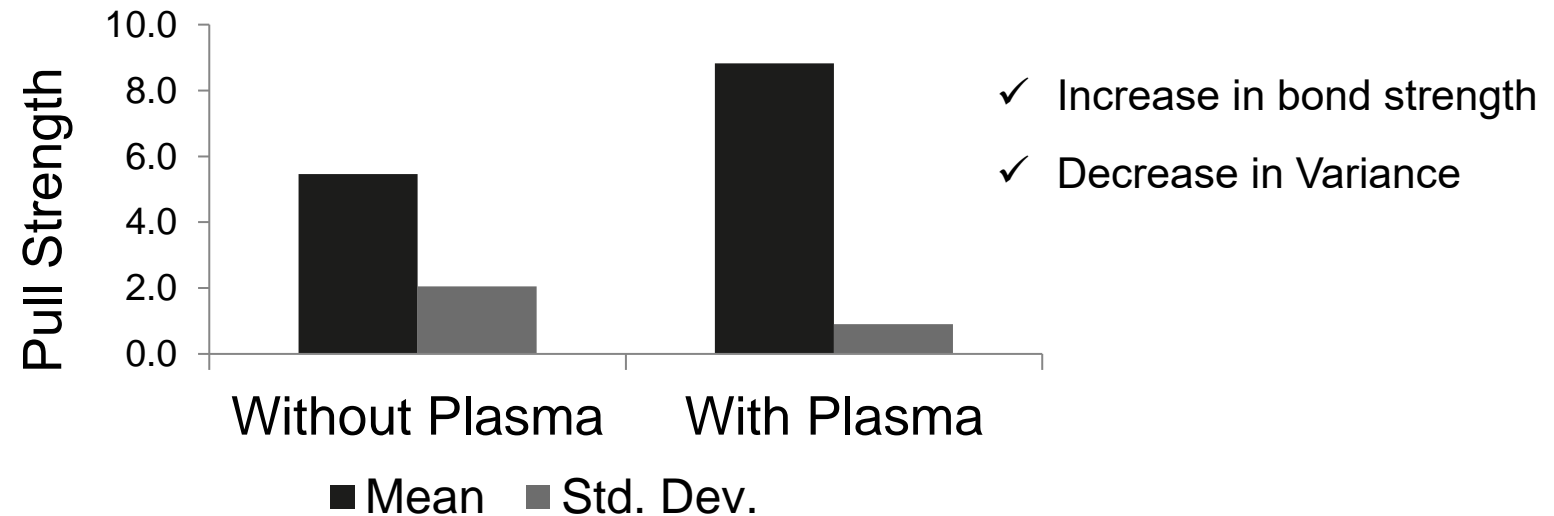


Pictures courtesy of PVA

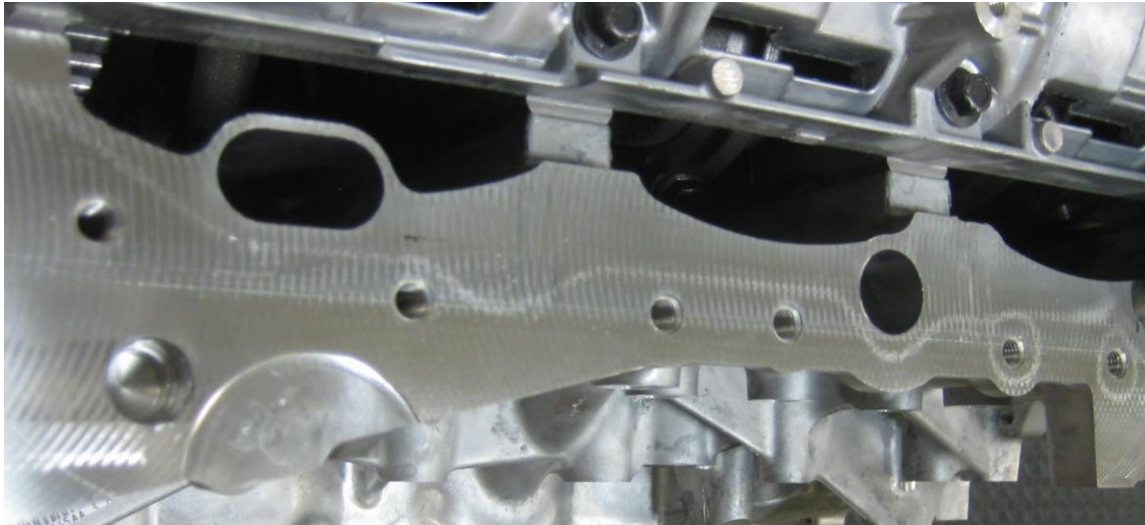
Manufacturing Automation



- Process Control
- Quality
- Safety
- Competitiveness



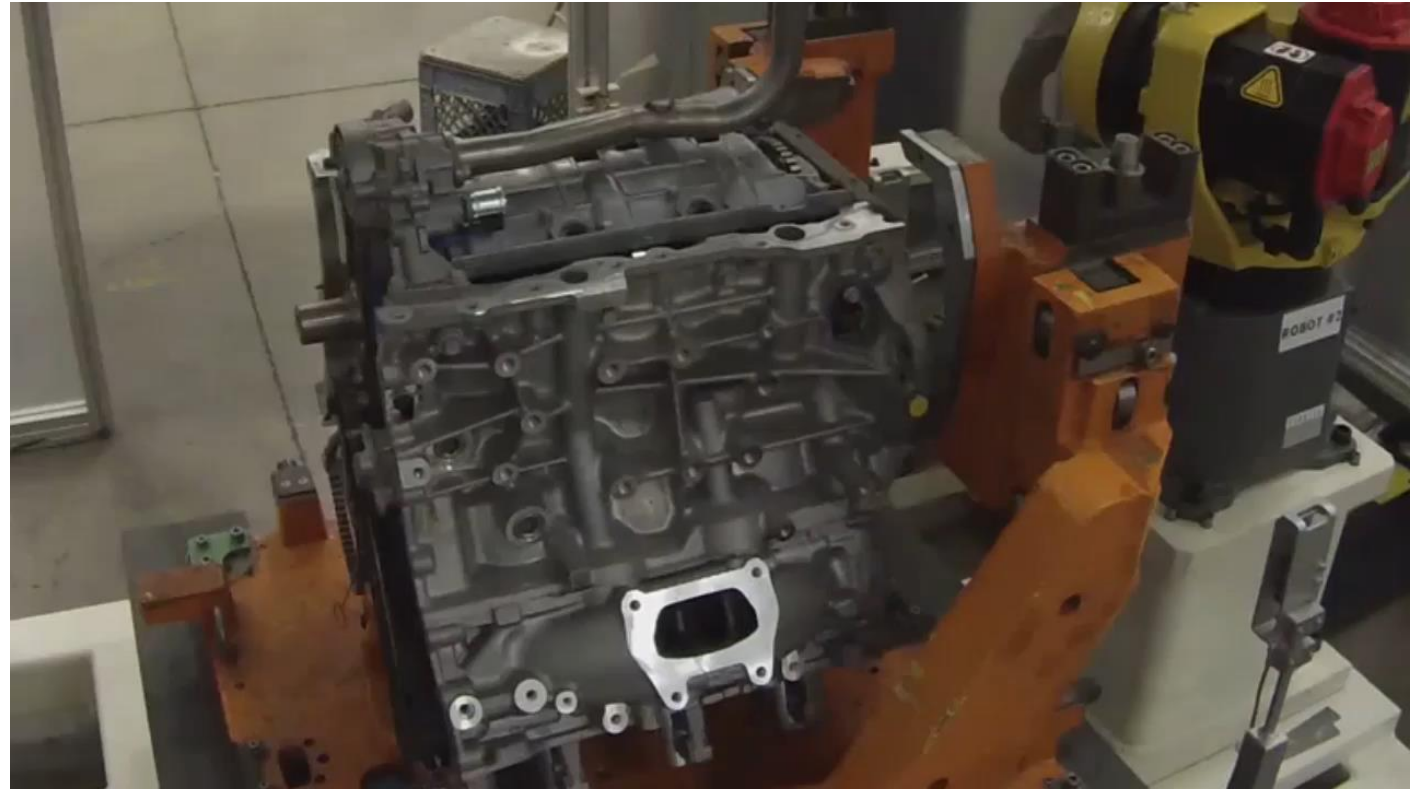
Engine and Drive



Transmission Housing Cleaning

- Cleaning & activation of aluminum transmission housing for increased adhesion before FIPG RTV silicone gasketing

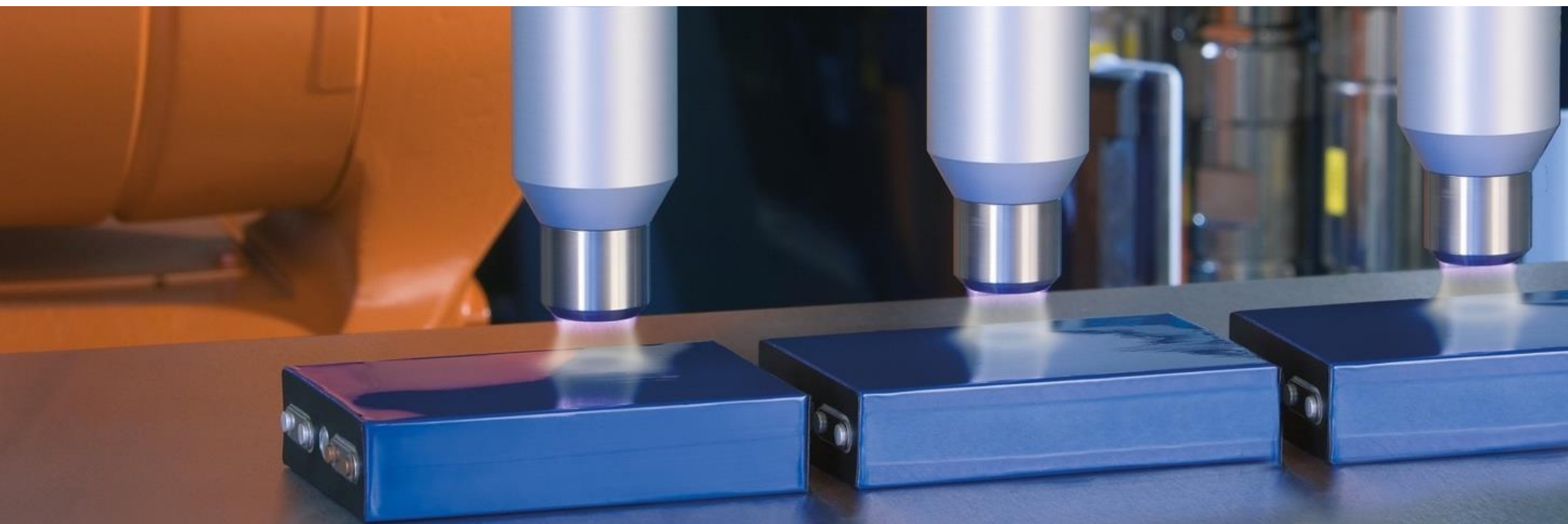
Engine and Drive



Engine Block Cleaning

- Cleaning & activation of aluminum engine block for increased adhesion before FIPG RTV silicone gasketing

Thank you for your kind attention



Richard Burke



Plasmatreat North America



603-560-7207



603-560-7207



Richard.burke@plasmatreat.com



www.plasmatreat.com