New Cleaning & Surface Preparation Technologies

SUR/FIN® Where Finishing Connects

2021 SUR/FIN Conference, Tyler Wheeler

ECOCLEAN

technology that inspires

Who Am I?

- Joined Ecoclean in 2010
- Held multiple positions:
  - Mechanical Designer
  - Project Engineer
  - Applications Engineer
  - Applications Manager / Product Line Manager
  - Product Line Manager / New Technologies

Tyler Wheeler
Product Line Manager
Tyler.Wheeler@Ecoclean-group.net

Who is Ecoclean?

Innovative Industrial Parts Cleaning & Surface Processing Technologies

Cleaning Automotive (CLA)

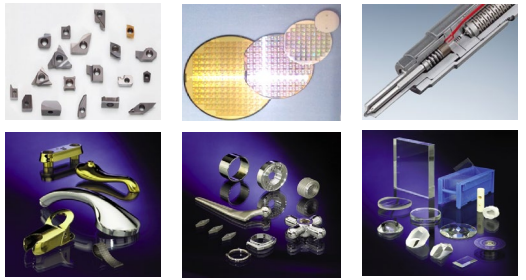
Cleaning, deburring, decoating, & activation systems for powertrain, engine, and transmission parts

Cleaning Industrial (CLI)

Cleaning systems for use in machining, stamping, and manufacturing applications via solvent & aqueous solutions

Cleaning Precision (CLP)

Cleaning systems for use in high precision markets such as medical, optics, semi-conductors, and applications with high requirements



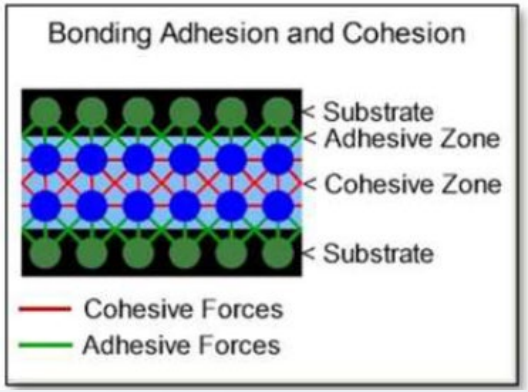
Trends & Technologies Driving Change In The Manufacturing Sector

- Increase in bonding applications
  - Requiring different types of cleanliness & surface preparation
  - Gluing of body panels and structural components
  - Integrating Sensors
- Greater usage of coatings
  - Thermal, wear resistant, PVD, CVD
- Industry 4.0
  - Smarter and more connected machines
- Demand for flexible systems

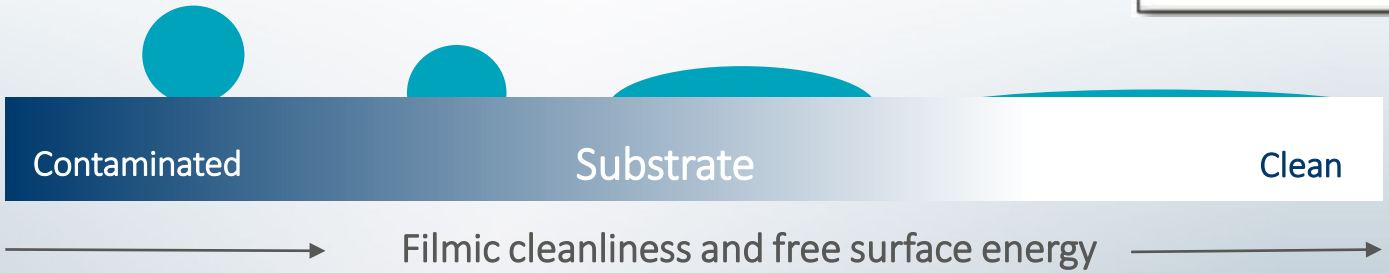
Preparing Parts For Bonding Or Coatings

Rising demand for ultra-fine degreasing

- Cleanliness is more than particulate
- Surface cleaning requirements are becoming increasingly common
- Rising requirements for subsequent processes such as gluing, painting, coating etc.



Wetting behavior of a substrate surface



Preparing Parts For Bonding Or Coatings

How Do We Measure The Surface Energy?

- Dyne Pens or Ink
  - Traditional method of checking a surface
  - Does not give an exact result and can be subjective
- Contact Angle Measurement
  - Increasingly popular method for verifying surface cleanliness
  - Gives an exact reading that can be tracked and compared

Contact Angle Measurement

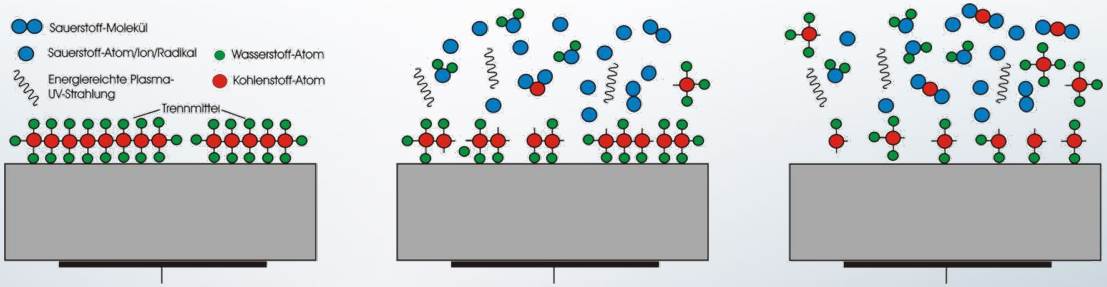
Adhesive bonding specimens

Plasma Cleaning
Preparing Parts For Bonding Or Coatings

Combined cleaning process : Wet and plasma cleaning

- Plasma cleaning as a supplementary / final cleaning step (ultra-fine degreasing)
- Removal of very thin filmy contamination (a few micrometers' thickness) such as greases, oils, lubricants etc.
- Dry and non-contact cleaning to achieve the highest surface cleanliness

Atmospheric Or Vacuum



(Source: Company Diener)

Vacuum Plasma Cleaning
Filmic Cleanliness in Focus

Parts

Wet cleaning with
integrated plasma cleaning

Subsequent process
e.g. coating, painting, bonding

Painted parts

Ultra-fine degreasing in a combined process in EcoCcore with integrated low pressure plasma

- No high investments
- No additional space required
- Optimized process times
- Lower operating costs

Maximal filmic cleanliness: EcoCcore with integrated low pressure plasma

Vacuum Plasma Cleaning
Combining Processes To Reduce Investment

Low pressure plasma

Maximal filmic cleanliness: EcoCcore with integrated low pressure plasma

Atmospheric Plasma Cleaning EcoCplasma

Fine cleaning and activating of car headlight before coating

Headlights (cars): plasma activating of headlight lenses made of polycarbonate for automobiles prior to coating with scratch resistant UV coating..

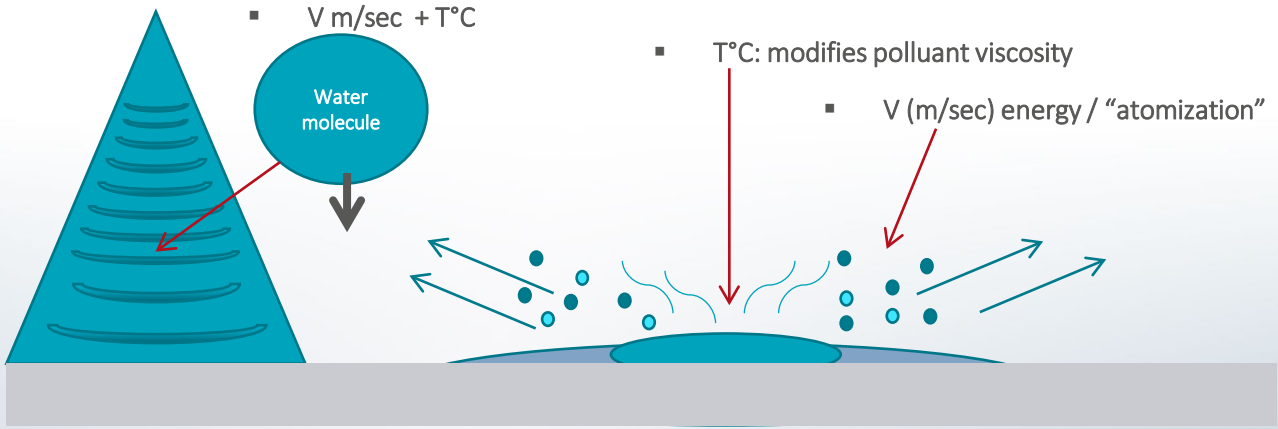
Discjet allows cleaning of undercuts

Atmospheric Plasma Cleaning
Increasing Surface Energy

Steam Cleaning
EcoCsteam Cleaning Process

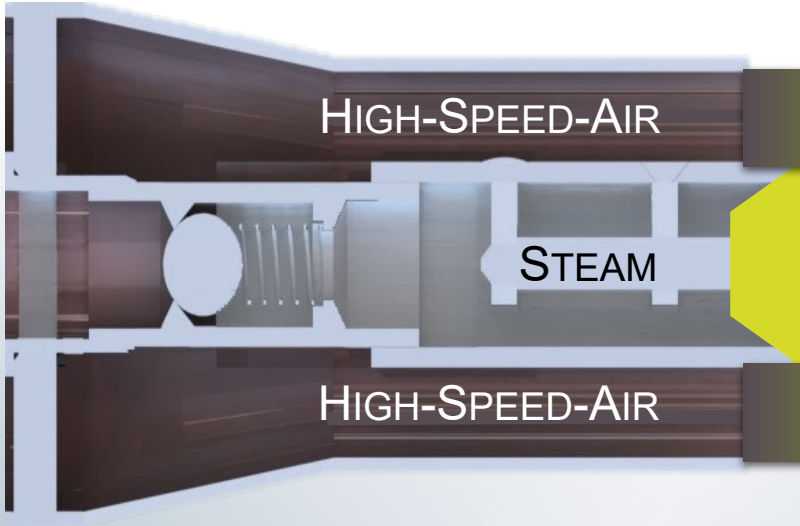
How does it work – Cleaning effect

The amount of moisture within the steam is determined in relation to the pollution which is to be removed.



- The steam quality of 0 indicates very wet steam (aggregate transition) while a steam quality of 1 indicates 100% steam, that is “dry” steam.
- Example: Steam with 95 % steam and 5 % of liquid entrainment has a steam quality of 0.95

Steam Cleaning
EcoCsteam Nozzle System



Mechanical cleaning effect due to passively heated high speed air

Removal of loose particles and dissolved contaminations due to temperature impact

Cleaning effect due to adjustable parameters

Wet content: Removal of polar contaminations e.g. salt

Temperature: Removal of non-polar contaminations e.g. grease

Increasing of working distance and optimization of real effective power due to

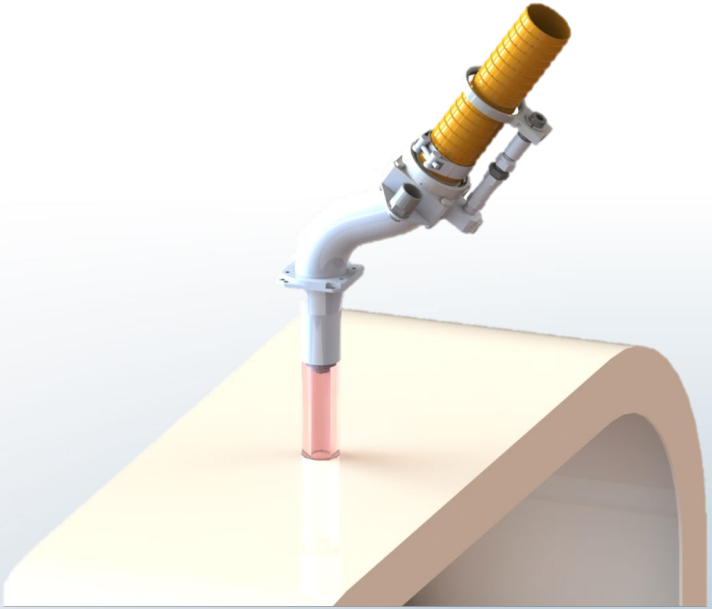
Packaging and accelerating of steam jet w/ high speed air up to 60m/s

Steam Cleaning In Practice

The **temperature** reduces the viscosity of film-type contamination and affects non-polar contamination (greases, oils,...).

The **dry steam** itself dissolves polar contaminations (salts, emulsions,...).

The **steam pressure** (possibly in combination with **high velocity air**) removes the dissolved contamination from the surface.

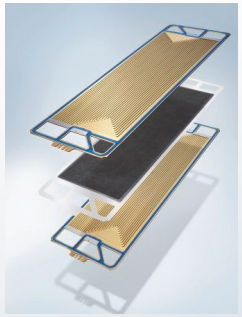


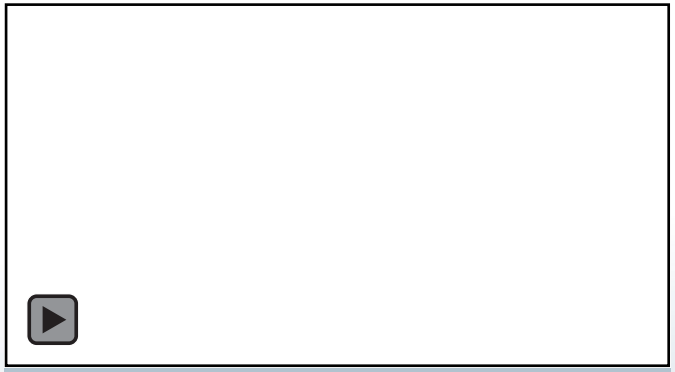
Surface Cleaning With Steam

Flat-jet nozzle

Round jet nozzle

Selective creation of defined surface tension before adhesive bonding / sealing





Cleaning / degreasing Bi-Polar plates

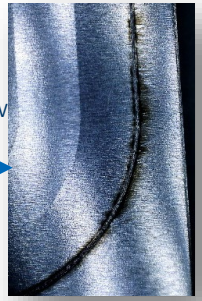
Bi-Polar plates: Cleaning of Bi-Polar plates for fuel cells before laser welding

Cylinder head: Cleaning of cylinder heads before sealing of cover

Surface Cleaning With Steam

Before

magnified view



After

Before

After

Laser Roughening

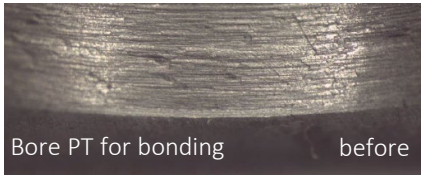
Typical laser

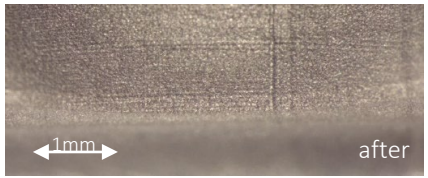
- short-pulse laser
- Wavelength λ mostly 1.064 nm
- Pulse duration usually approx. 100 ns
- typical power range: 50-500 W

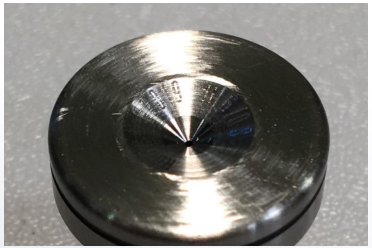
Features & Benefits

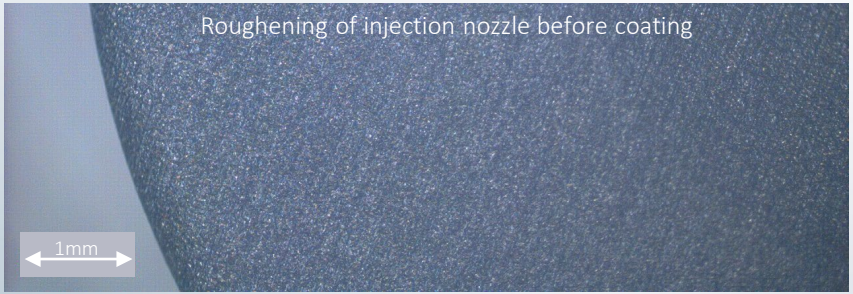
- selective machining with precise contours, in particular of metal
- low heat input into the component

EcoClaser – Partial Surface Processing









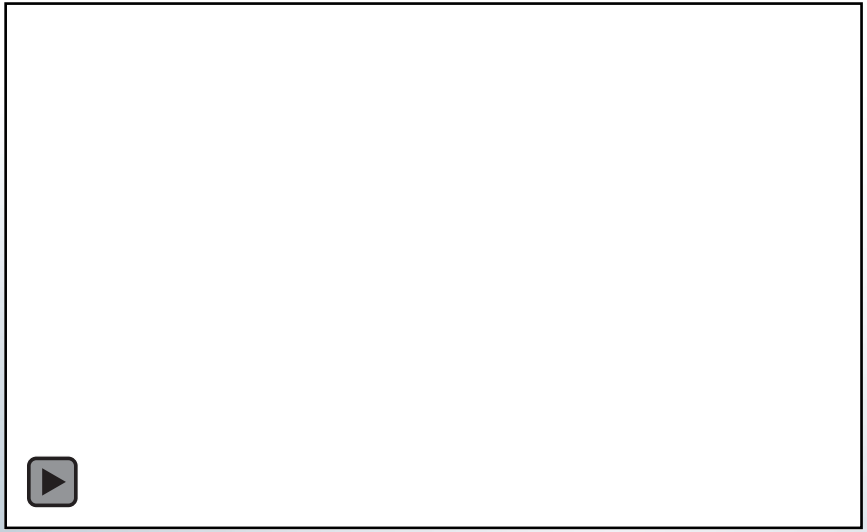
Application examples:

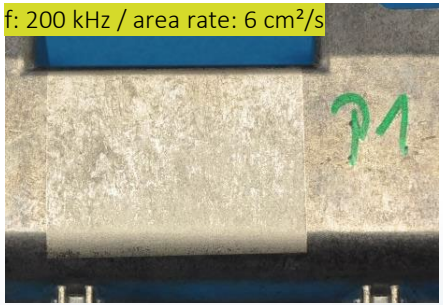
- **Pretreatment (PT)** of housing grooves before sealing / gluing
- **Decoating** of e.g. CDC layer for ground contacting
- **Cleaning with / without roughening** for improved adhesive bonding
- **Cleaning before** welding or soldering
- **Cleaning after** welding (smoulder)
- **Roughening** before coating

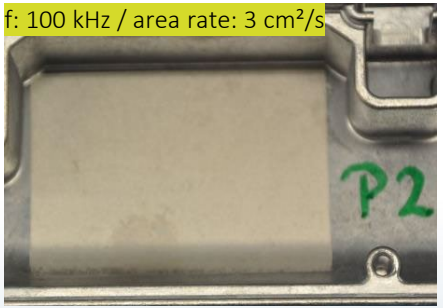
Laser Cleaning & Surface Preparation

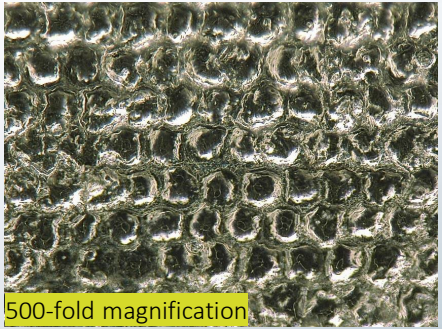
Die-cast aluminium housing

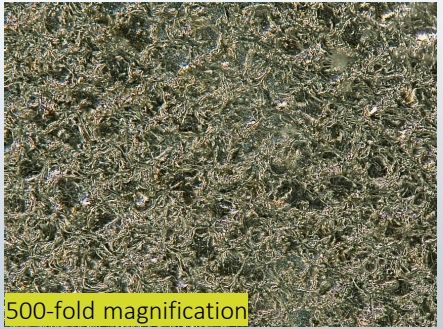
Cleaning and roughening before gluing in an electronic module









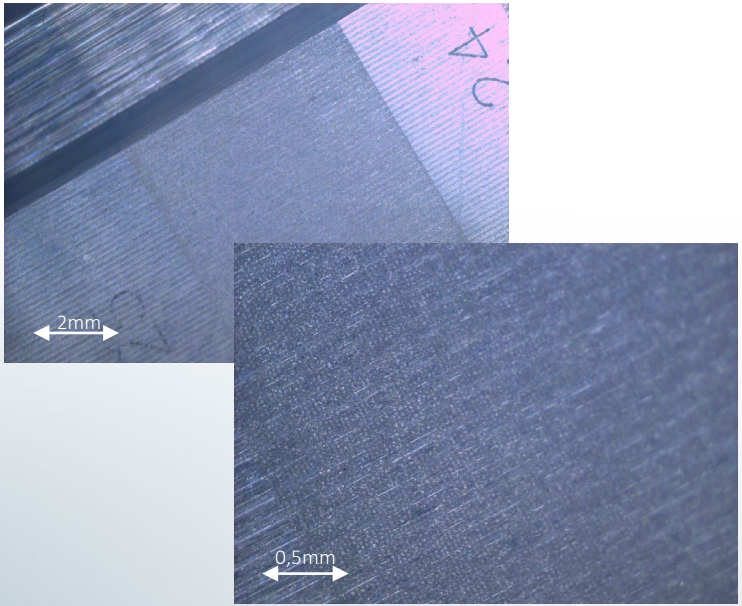


Source (video and pictures): cleanLASER

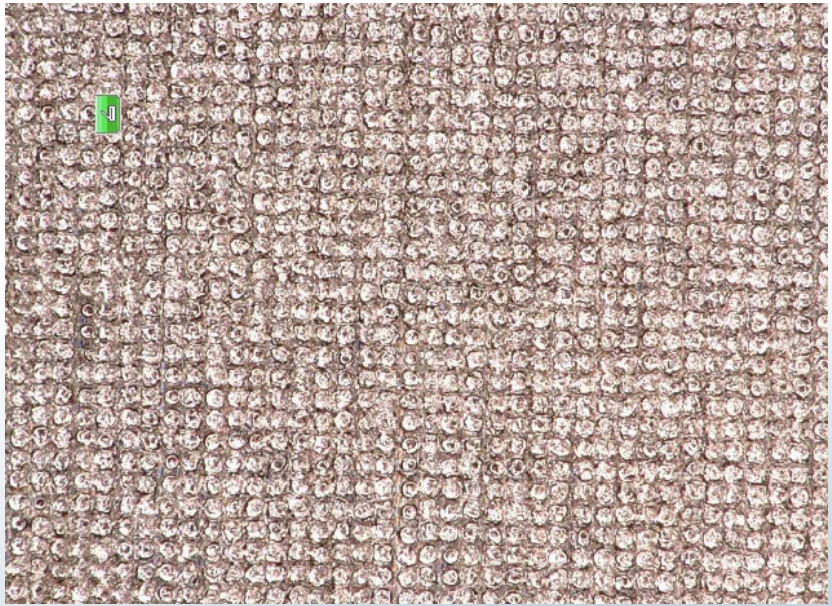
Laser
Roughening Bearing Surface Before Coating

Microscope image after application

Aluminum



Bronze



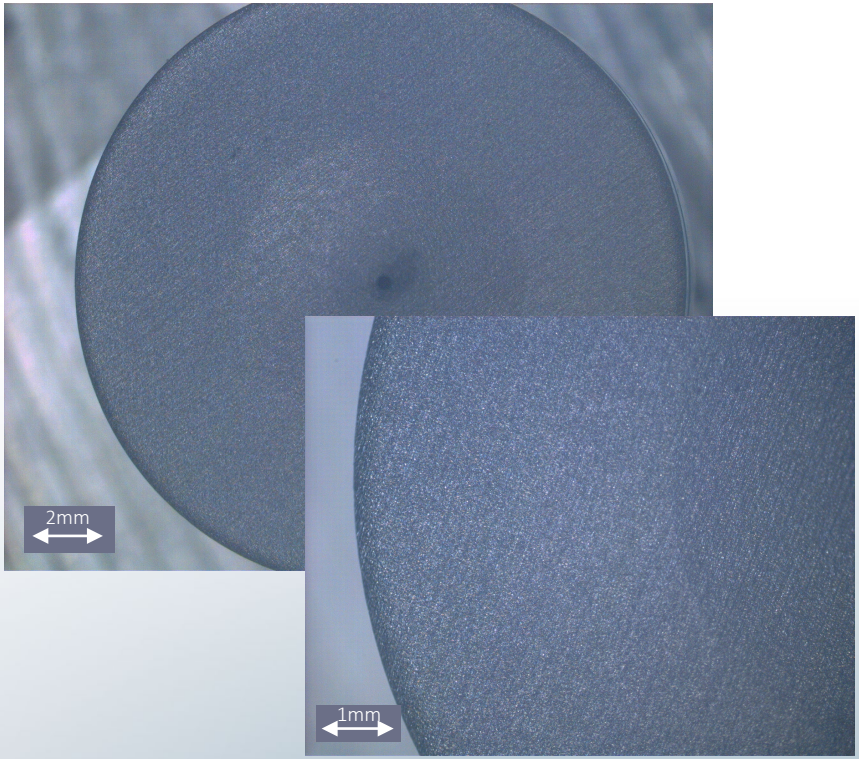
The layer had to be roughened to Ra = 1 µm as pre-treatment for polymer-coating.

EcoClaser – Roughening of injection nozzles

Task

Roughening top side (highlighted yellow in left picture) to

Ra = 2 µm resp. 4 µm as pre-treatment before thermal coating.



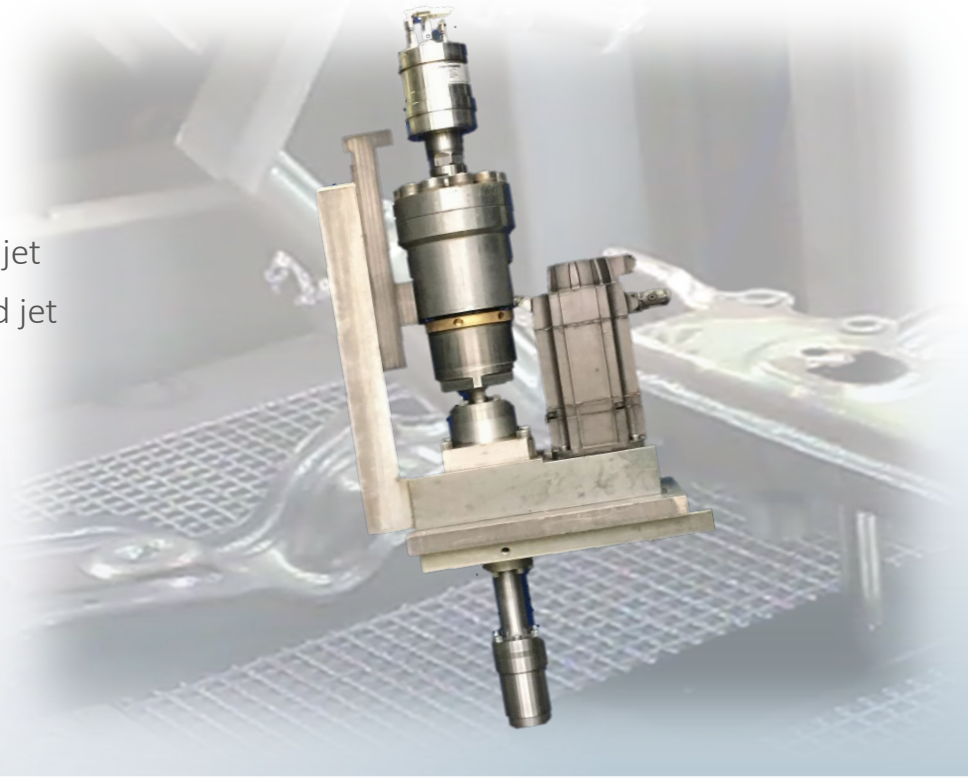
EcoCbooster
Cleaning, Texturing & Decoating Surfaces

Process system

- Rotating high-pressure nozzle
- Variable rotation speed
- Ultrahigh-frequency high-pressure pulsed water jet
- Available nozzle geometries: flat jet nozzles, solid jet nozzles, lances…

Treatment options

- Tool is handled by robot
- Part to be treated is handled by robot
- Focussed impact area

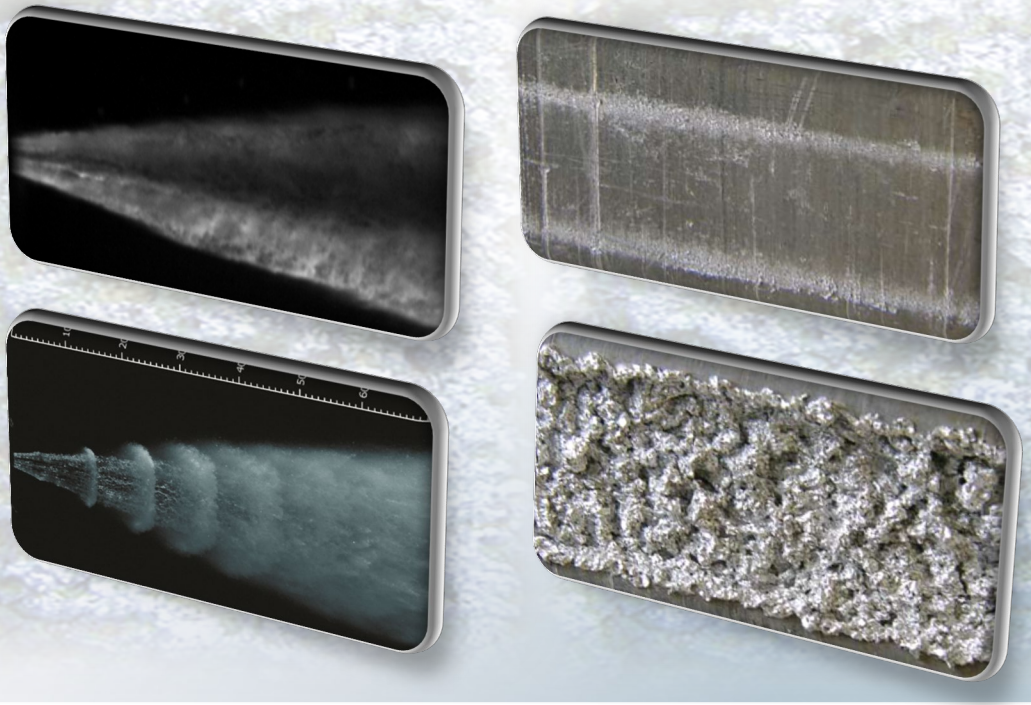


EcoCbooster Vs Conventional High-Pressure

Process features

Conventional high-pressure water jet
Flow velocity
at 600 bar: 343 m/s

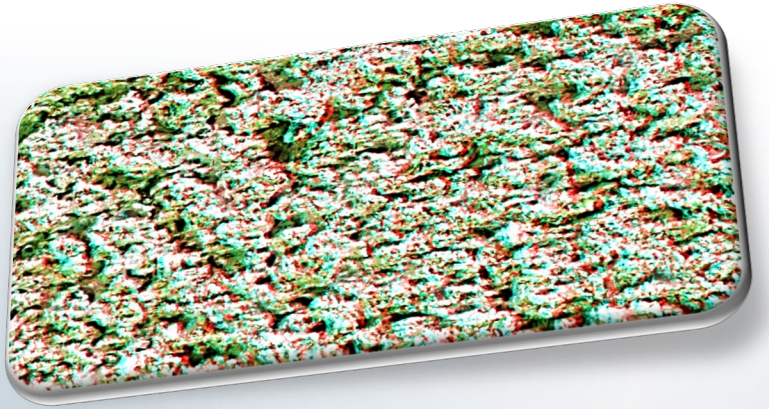
Pulsed high-pressure water jet (EcoCbooster)
Pulsation frequency:
40,000 Hz

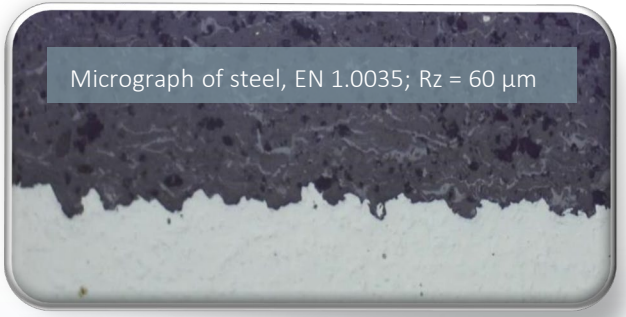


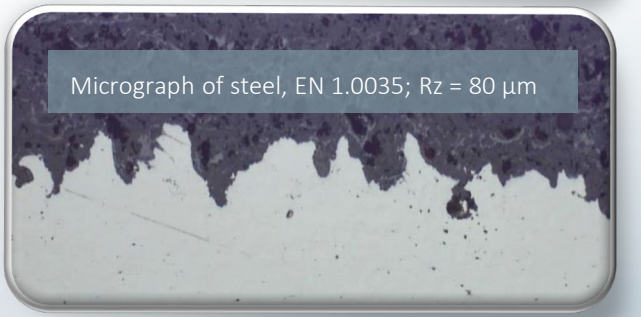
EcoCbooster
Texturing & Activating Surfaces

Modifying surface texture

This highly enlarged view depicts a **surface texture** obtained with the Booster-based activation process.

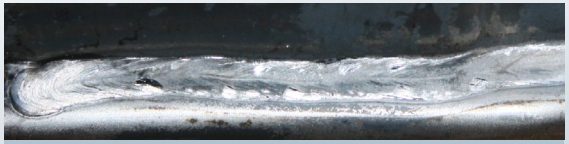






Weld Seam Cleaning With EcoCbosster

Weld cleaning prior to cathodic dip painting (CDP) – Substitute for ceramic blasting
Roughening surfaces of aluminium structural parts before adhesive bonding



Weld seam after cleaning

Weld Seam Cleaning With EcoCbosster

Weld seam cleaning requirements

Removal of:

- Silicate and weld spatter
- Casting flash and burrs
- Oxide layers
- Scale and soot residue
- Baked-on oil and grease

Parts treated

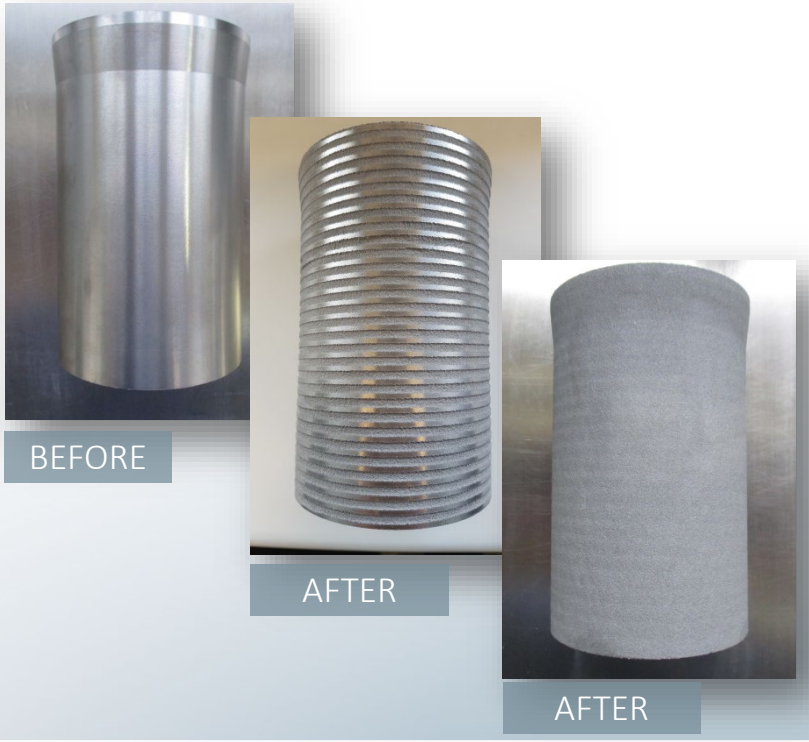
- Axle components, engine subframes
- Automotive body parts
- Frame structures
- Precision tubes
- Design trimmings
- etc.

Texturing Surfaces With EcoCbooster

Surface texture

EcoCbooster is able to create various surface textures.
These photos illustrate the **Booster's** effectiveness in surface activation applications on the example of a cylinder liner.
This treatment guarantees perfect adhesion characteristics.

Notice:
This process requires **NO abrasives** whatsoever.



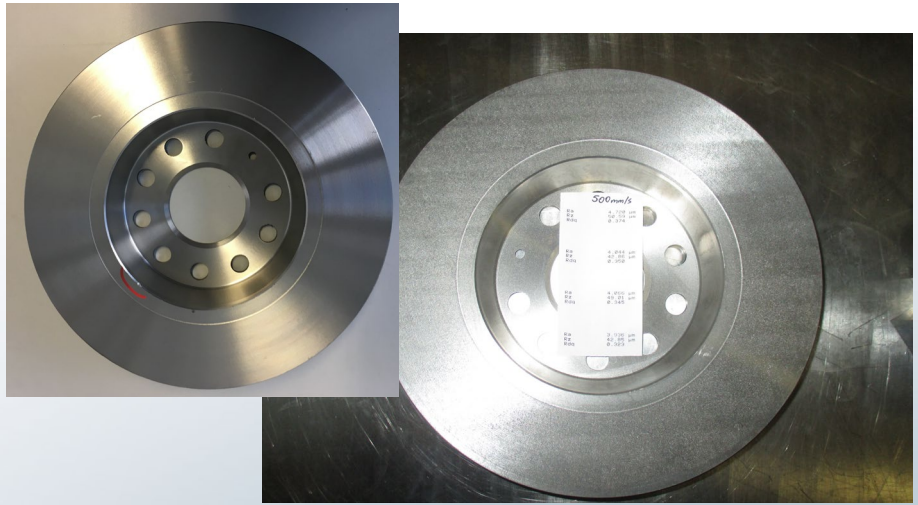
EcoCbooster
Activating Suraces For Coatings

Surface activating of brake discs prior to coating

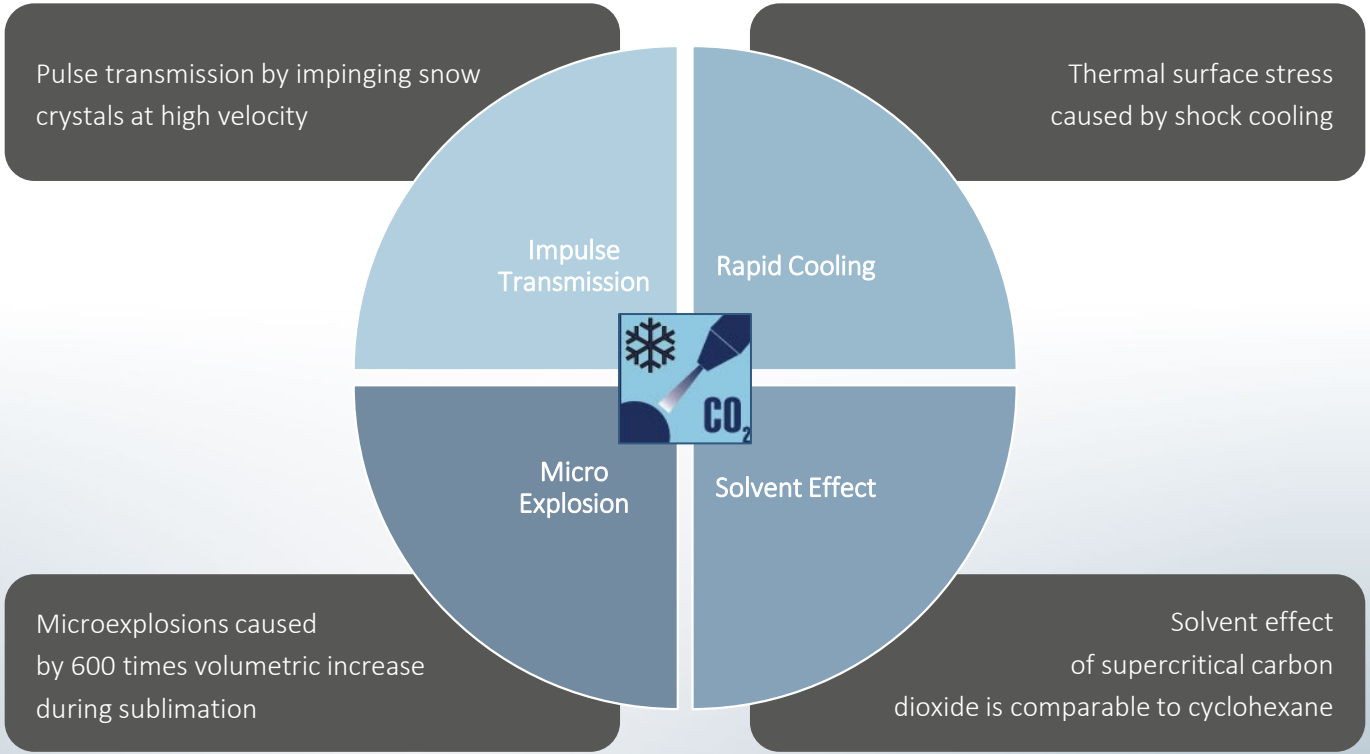
Electrically powered vehicles require brake rotors with superior anticorrosion properties. Cutting ambient levels of fine particulates requires less brake rotor wear.
→ Coating of brake rotors

Brake discs: roughening of surfaces prior to coating of brake discs

Brake discs: elimination of oxide in substrate of casted brake discs prior to coating (corrosion protection)



CO2
Cleaning Technology



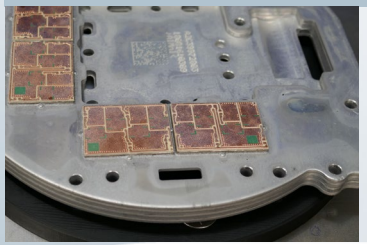
CO2
Delivery Methods

Snow for cleaning made of pellets

Snow for cleaning made of CO2 gas

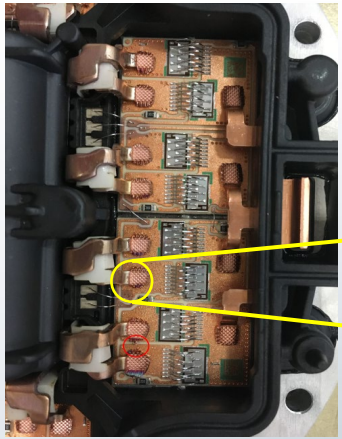
CO2
Electronics Cleaning & Deburing

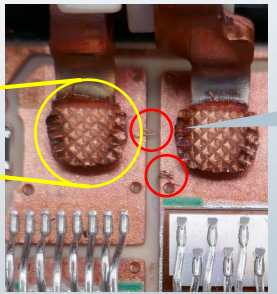
Removal of residual fluxing agents on inverter housings



Inverter housing: Cleaning of Inverter housings after soldering – remove residuals of fluxing agents (left hand photos)

Inverter housing: Cleaning of inverter housing (assembled) removal of fine burrs after ultrasonic welding (right hand photos)





fine burrs after ultrasonic welding

CO2
Cleaning Example

Before	After
	

Cleaning of soot from spring plates

Selective Cleaning - Our Test Lab - Your Toolbox

Our test area for selective cleaning in Germany

We have the ability and the know how to serve our customers with the best fitting processes for their special needs in terms of selective cleaning and surface treatment.

Questions?

Tyler.Wheeler@Ecoclean-group.net

ECOCLEAN

technology that inspires

ECOCLEAN

SBS ECOCLEAN GROUP

Ecoclean Inc.
26801 Northwestern Hwy
Southfield, MI 48033
USA

ECOCLEAN UCM MHITRAA

www.ecoclean-group.net

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