

# IST

# International Surface Technology

The International Edition of **JOT**  
Germany's Leading Magazine for Surface Technology

## **Airless Sprayers**

Improved Performance  
in Harsh Conditions

## **Two-Layer Passivation**

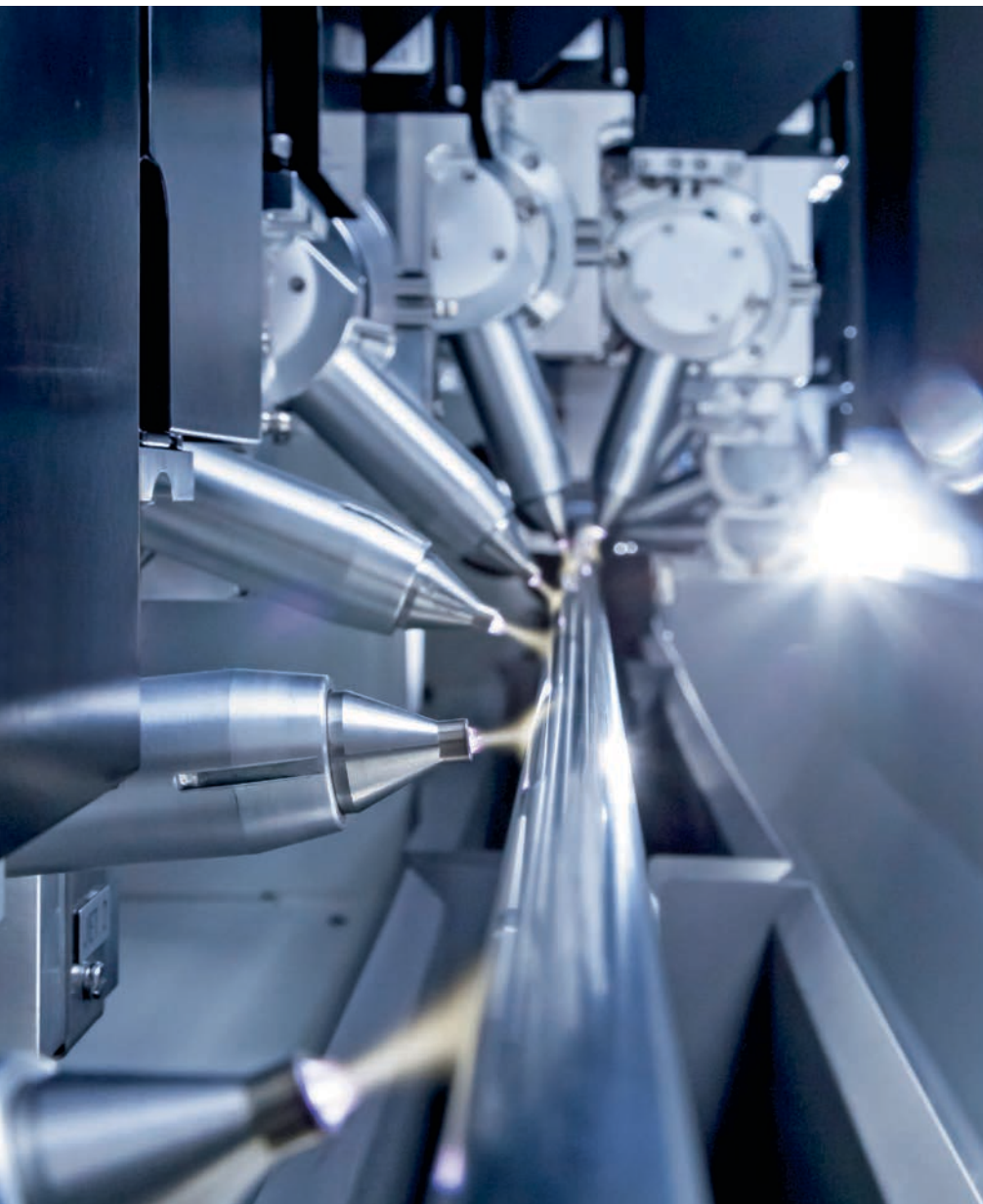
Protection Layer  
by Layer

## **Technical Cleanliness**

When are Parts  
Sufficiently Clean?

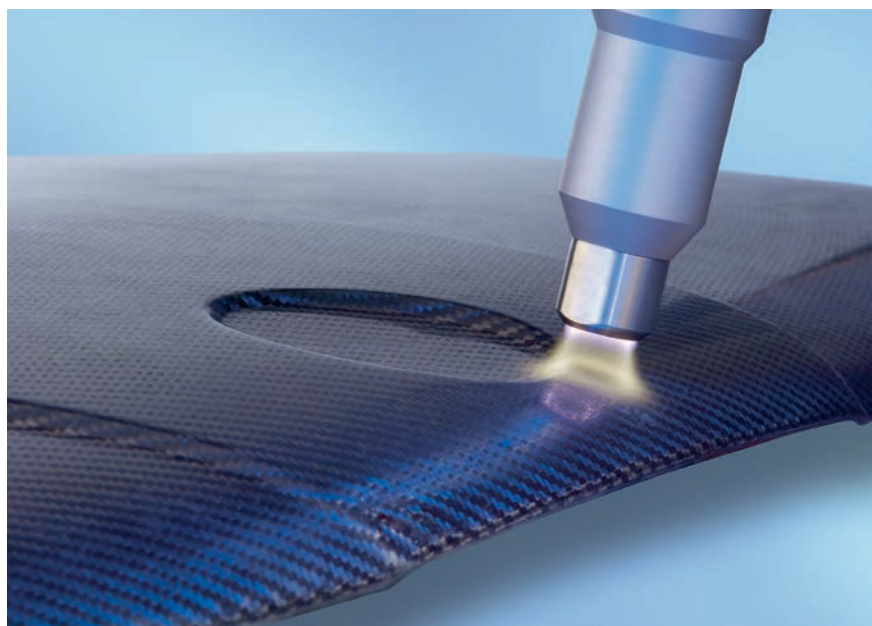
# Reliable Adhesion of Water-based Paints

Safeguarding the quality requirements of painting processes starts with the pretreatment of the material surface. Where solvent-free, water-based paint systems are used, the environmentally friendly, highly effective pretreatment with atmospheric pressure plasma is the method of choice.



A flawless paint finish with long-time stable adhesion is impossible to achieve without cleaning contaminated metal surfaces to a microfine level and activating non-polar plastics that are resistant to adhesive bonding. There are various methods of cleaning and activation, with the use of wet chemicals being by far the most widespread. Over 50 percent of VOC (volatile organic compounds) emissions are generated through the use of solvents. According to the Baden Württemberg State Institute for the Environment (LUBW), painting operations are responsible for the lion's share of such emissions/1/. 'Surface energy' is the holy grail when it comes to wettability and adhesion. Whether paints and adhesives achieve the desired level of adhesion to the substrate largely depends on surface energy. Good wettability is conditional on the material surface being ultra-clean and the surface energy of the solid material being higher than the surface tension of the liquid paint or adhesive. Solvent-based pretreatment processes are harmful to the environment, often harmful to health and involve high energy and disposal costs. So it is not surprising that, in an age of greater environmental awareness, car manufacturers are seeking alternative solutions and the trend is shifting towards water-based paint sys-

**Figure 1** > Hutchinson reduced the scrappage rate to a minimum by treating their EPDM profile seals with plasma before applying water-based paints.



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**Figure 2** > With plasma cleaning, any residual release agents on fiber-plastic composites such as CFRP and GFRP are broken down and eliminated in seconds before painting. The plastic is activated at the same time.

tems and consequently, equally environmentally friendly pretreatments for material surfaces. An example of an environmentally safe, economical and yet highly effective pretreatment process is the use of atmospheric pressure plasma.

### High-quality paint finish with water-based paints

Openair-Plasma technology developed by Plasmamatreat and used worldwide is a dry, chemical-free pretreatment process which, when applied to material surfaces, not only creates optimal adhesive characteristics in seconds, it also ensures that high-quality finishes are achieved with water-based paints. The environmentally friendly process needs nothing other than compressed air as the process gas and electrical energy.

The in-line jet systems are computer-controlled, screen-monitored and fully compatible with robotic applications, while the processes themselves are robust and reproducible. The use of Plasmamatreat processes enables conventional pretreatments such as solvent-based cleaners and primers or manual surface brushing and rinsing to be dispensed with entirely in most cases. Unlike wet-chemical pretreatment methods, this approach renders drying and interim storage unnecessary, so components can be painted immediately after atmospheric pressure plasma cleaning and activation. Not only can the process eliminate process steps and significantly reduce energy consumption and operat-

ing costs, it can also substantially increase throughput and product quality.

### Plasma for water-based paint systems

Switches with laser-cut symbols, high-gloss decorative trims and covers, scratch-resistant painted display windows and sparkling panels, air vents or glove compartments – the plastic components in car interiors nowadays have very sophisticated painted finishes. And manufacturers are increasingly turning to water-based paints.

### Plastic switches in the vehicle interior

TRW Automotive Electronics & Components in Radolfzell, Germany, pretreats millions of switches for car interiors a year with atmospheric pressure plasma prior to painting. At their factory, six rotary plasma nozzles work in-line around the clock. They clean and activate visible parts made from PC or PC+ABS before painting, including complex 3D geometries such as steering wheel covers as well as simple 2D components. A high degree of process reliability is top priority and this is achieved through the computer-controlled and screen-monitored system provided by the plasma systems engineer. According to the manufacturer, throughput has tripled since they started using a new water-based painting line with integrated plasma system and stopped using primers. Furthermore, not only has a complete run incorporating six operations been dropped, it has also been possible to

save a great deal of time and 90% of the energy costs compared with the previous cleaning systems and a primer activation.

### Airbag covers

In China thousands of airbag covers made from TPE (thermoplastic elastomer) are produced each day for a Tier 1 automotive component supplier. Since this plastic has low surface energy, before painting with water-based paint it must be pretreated to improve its adhesive characteristics. For reasons of cost and environmental protection, the main concern for the manufacturer was to replace the fluorination process normally used on these components with the atmospheric plasma process.

### EPDM seals

Hutchinson, one of the world's leading manufacturers and processors of high-quality elastomer products, has been using plasma technology to pretreat their EPDM profiles for the automotive industry since the late nineties.

Seals are found throughout vehicles, from the engine compartment, doors and windows to the battery housing, trunk and in many other places. Hutchinson uses twelve Plasmamatreat systems to activate around 100 different EPDM profiles with different geometries. An essential production step is to increase the surface energy of the seals prior to subsequent water-based painting or flocking to improve adhesion.

The primer previously used as an adhesion promoter was applied with a spray gun before painting. When the gun malfunctioned, problems arose with paint adhesion, leading to high scrappage rates. Before flocking – the process of depositing very fine polyamide fibers (flock) onto an adhesive – rotary brushes were used to roughen the EPDM surface, which generated a great deal of dust. Switching to atmospheric pressure plasma completely eliminated these two methods. The result: Scrappage rates were reduced to a minimum, rigorous environmental protection was finally achieved through the elimination of solvents and production throughput rose significantly (*Figure 1*).



**Figure 3** > Openair-Plasma removes all impurities and organic contaminants from metal surfaces.

### Painting fiber composite materials

Plasma treatment not only replaces conventional methods of preparing SMC (sheet molding compounds / fiber-plastic composites) – such as sanding or cleaning with acetone – it also produces superior painting and bonding results. Nowadays automotive parts such as vehicle roofs, trunk lids or hoods are mainly molded from carbon fiber-reinforced plastic (CFRP) or glass fiber-reinforced plastic (GFRP). Release agents are required to remove the complex individual parts safely from the molds after production. After demolding, components from these release agents remaining on the surface must be laboriously removed. With plasma cleaning, on the other hand, any residual release agents are completely broken down and eliminated in seconds before painting. The plastic surface is activated at the same time (*Figure 2*).

### Plasma before painting metals

Layers of dust deposits, grease, oils and other contaminants can often compromise the naturally high level of surface energy in metals, thereby impairing wettability. Openair-Plasma technology creates the critical conditions required to ensure the reliable adhesion of coatings as well as uniform paint distribution, especially with the aluminum alloys used in the automotive industry, but also with stainless steels and other metals. Operating at very high speed, the plasma cleans and activates the metal surface only in places where treatment is actually needed – in other words, it is area-selective. It works at molecular level to remove all impurities and organic contaminants from the surface (*Figure 3*).

The plasma effectively restores the original surface energy to make complete wettability possible. Where a highly adhesive oxide layer has already formed on the aluminum or complex geometries are involved, this technology enables the plasma to be combined with a laser jet to create a hybrid technology for the targeted removal of the layer.

The Turkish automotive component supplier Mata Automotive, which specializes in sophisticated decorative trims for well-known automotive manufacturers such as GM and FCA, uses the Openair-Plasma technology – not just for the pretreatment of CFRP (carbon fiber-reinforced plastic), but also for the environmentally friendly microfine cleaning and activation of the metallic badges on the Corvette z06 before painting. The plasma process has completely replaced the primer process that this supplier was still using three years ago.

### Conclusion

Apart from the triple action effect – ultrafine cleaning, static discharging and area-selective activation – and the possibility of functional nanocoating in the form of plasma polymerization, other factors which have persuaded users to switch to plasma technology include high process speed, high process reliability and accurate process reproducibility. The technology provides other desirable features such

as easy integration into process operations and signal chaining to higher and lower-ranking control units, as well as satisfying requirements for total environmental compatibility. //

*Inès A. Melamies, specialized journalist, Bad Honnef, Germany*

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### Literature

/ 1 / [https://www4.lubw.baden-wuerttemberg.de/servlet/is/14150/energie\\_stoffstromoptimierung\\_lohnlackierung.pdf?command=downloadContent&filename=energie\\_stoffstromoptimierung\\_lohnlackierung.pdf](https://www4.lubw.baden-wuerttemberg.de/servlet/is/14150/energie_stoffstromoptimierung_lohnlackierung.pdf?command=downloadContent&filename=energie_stoffstromoptimierung_lohnlackierung.pdf)

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