

## Aircraft painting: Efficient and environmentally friendly pretreatment of fibre-composite materials by means of innovative process technology

Ever more aircraft manufacturers are using novel, low-cost pretreatment methods based on plasma technology for their machines

The shiny high-gloss coatings that airlines use are not just for visual appearance, a much stronger motivation is to protect the aluminium structure from harsh environmental conditions because the coatings safeguard the machine against corrosion. At the same time the trend to high-performance composites in aircraft presents new challenges for pretreatment and painting.

Pretreatment of the aluminium surfaces of aircraft bodies is the first step in a hitherto multistage coating process encompassing acid etching, conversion coatings, primers and finishing lacquers. These processes are common and determined by hundreds of process specifications. The first step frequently involves solvent baths, irradiation by suitable means or rubbing down by hand. However, the pressure to avoid or to reduce the use of solvents, noxious materials as well as the quality variations in manual work is increasing greatly.



Photo: Rokit, [www.photocase.com](http://www.photocase.com)

Carbon-fibre reinforced plastics are being used ever more frequently in key parts. The mould release agents left behind after this process can be removed by plasma.

Openair plasma technology from Plasmatrete based in Steinhagen is an innovative process whose application aims to circumvent these problems. The atmospheric-pressure plasma technology – a stable high throughput process – is characterised by a threefold principle of action: it activates surfaces by selective oxidation processes, removes static charges and brings about microfine cleaning

of surfaces. These effects in turn ensure optimum conditions for the adhesion of paint. The system is suitable without any restrictions for in-line integration and is compatible with robots and as a result, according to information from the manufacturer, low-cost solutions are made possible.

The atmospheric-pressure plasma system is suitable for the rapid

treatment of both large-area parts such as aircraft wings or fuselage components as well as small areas. The process can be readily adapted to complicated geometries. Because it operates under atmospheric conditions large vacuum chambers and pump systems needed for low-pressure plasma systems are rendered unnecessary.

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### Environmentally friendly and emission-free

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The plasma process removes static electricity and dust from surfaces – the precondition for a high-quality painted surface. A particular feature of Openair plasma is the intensity of the emergent beam. It is so high that treatment speeds of several 100 m/min can be achieved.

The atmospheric-pressure plasma is economical to run since it requires only compressed air and electric power. It is environmentally friendly and produces no emissions harmful to health or waste

products. It can reduce or avoid the use of solvents.

Since proximity to the treated surface and speed of treatment are fundamental the plasma jet under robot control can provide repeated cleaning and activation of the surface. Accordingly, the variability and costs associated with rubbing down by hand or irradiation by suitable means can be avoided.

Anticorrosion primers are frequently employed for interior parts of the aircraft fuselage and in wing structures having reinforcing and fastening devices as well as in countersunk riveted assembly parts. These areas are often difficult to clean and pretreat.

Countersunk rivet edges are susceptible to damage and form a starting point for corrosion. Since the plasma can reach these very restricted areas and operates without contact, reliable adhesion of coatings can be achieved without damage to these areas susceptible to corrosion.

On account of requirements for low weight, improved material fatigue

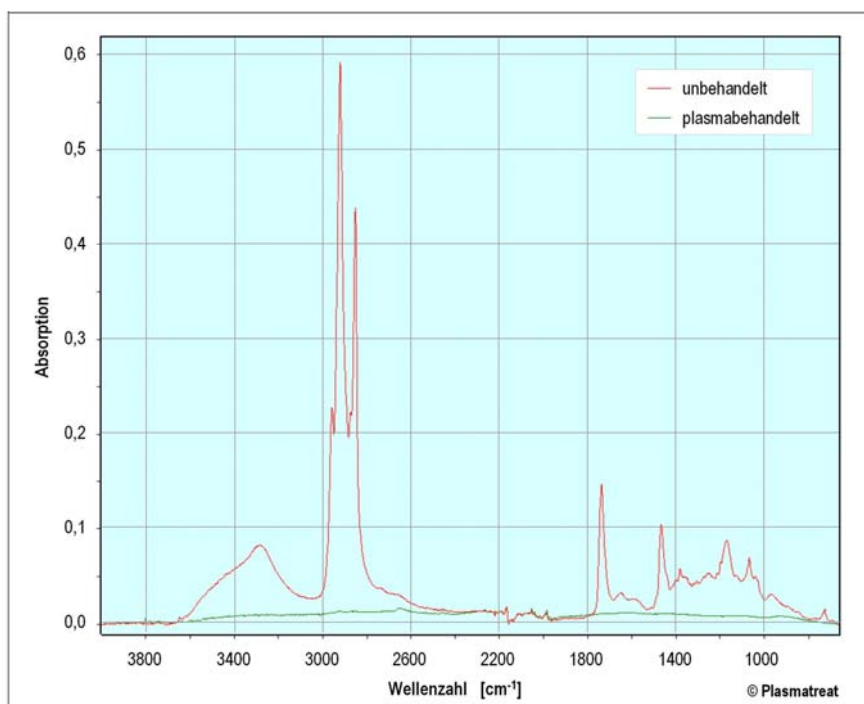
characteristics and corrosion resistance sophisticated composites are increasingly being used in aircraft. These are layered materials usually produced in casting moulds from plastic reinforced with carbon fibres and cured at relatively high temperatures. Starting with fibre glass composites in secondary components, such as payload claddings and covers, carbon fibre composites are used in the main components such as aircraft wings, control elements and fuselage parts. These cast parts are contaminated by mould release agents which frequently contain silicones. In order to ensure reliable painting these contaminants must be removed completely. Only then is it guaranteed that subsequent painting or bonding tasks will meet the highest standards of quality.

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### Activation brings about better adhesion of paint

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Plastic surfaces in composites are often chemically inert since their long polymer chains have only low surface tension and possess no or only few functional groups. As a result of this they are difficult to paint adhesively. The ions and free electrons in the plasma beam cause nitrogen and oxygen to bond to the surface of the polymer so that functional groups such as –OH and –NH are produced. “In this way the plasma activates the surface by selective oxidation processes, discharges it and results in microfine cleaning. The rise in temperature of the plastic surfaces during treatment in this case amounts to  $\Delta T < 20$  °C. Activation of the surface takes place and this has a positive effect on adhesion”, declares Plasmatreat Managing Director Christian Buske.



Infrared spectroscopy measurement. In the course of the fine cleaning of metal surfaces Openair plasma removes all impurities and organic contaminants such as grease and oils as well as water adhering to the boundary layer. (red = untreated, green = plasma-pretreated)

In addition to cleaning, the reactive components in the plasma interact with the composite material and activate it so that it undergoes correct chemical bonding to the paint or coating system. This mechanism is the principal reason for the improved adhesion.

The decisive advantages in the use of this system are additionally the

reliability and quality of the method in the production process.

Accordingly, the high demands of manufacturers in the aircraft production industry can be met. Furthermore, other desired characteristics such as straightforward integration into production lines, higher economic efficiency and environmental friendliness are providing an

extraordinary and useful novel technology.

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