

**SURFACE TECHNOLOGY: ATMOSPHERIC-PRESSURE PLASMA
TREATMENT OPTIMISES ADHESIVE BONDING PROCESSES**

Protects the environment and the pocket

Atmospheric-pressure plasma treatment is a versatile, economically efficient and environmentally compatible tool in processes for cleaning, activating and coating surfaces composed of plastic and metal.



Whether it be glued joints in folding boxes or injection moulding technology, whether it is the surface treatment of wafers or coating CDs, whether it be applications in microelectronics, medical technology and textiles or in automotive engineering, shipbuilding and aviation, there are scarcely any limits to the universal use of atmospheric-pressure plasma treatment.

In the installation of headlights pretreatment with Openair plasma ensures a firm diffusion-tight adhesive joint and a secure seal against the penetration of moisture
Photo: Plasmamatreat

Atmospheric-pressure plasma is opening up numerous novel applications in industry, especially when used in processes for cleaning, activating and coating. An example is Openair plasma technology from the system development company Plasmamatreat GmbH based in Steinhagen, Germany. It is characterised by a threefold action: it activates the surface by selective oxidation processes, simultaneously electrically discharges it and removes loosely adhering particles due to the high air currents produced.

> NEW TECHNOLOGIES

In the near future the atmospheric-pressure plasma process will greatly extend the application possibilities in coating materials of different types. With the Openair plasma technology from Plasmatreat a tool is available that builds up different layers efficiently and selectively more thickly than was hitherto possible by the low-pressure process. In addition it is able to integrate these layers into continuous processes.

A special characteristic of the emergent beam of plasma is that it is electrically neutral which greatly extends and simplifies the range of situations in which can be used. Its density is so high that machining speeds of several hundred m/min are possible. The typical heating of plastic surfaces during treatment amounts to $\Delta T < 20 \text{ }^\circ\text{C}$.

The technology developed by Plasmatreat owes its worldwide expansion in just a few years to a particular feature: whether used in injection moulding or printing machines, in gluing or painting installations, the jet systems used are always installed by the user directly in the assembly line.

"Our system is capable of in-line installation without restriction and is compatible with robots" reports Managing Director Dipl.-Ing. Christian Buske. "By using Openair plasma we have succeeded inter alia in substantially rationalising the removal of mould release agents on polyurethane (PU) mouldings by comparison with conventional methods."

Examples of the successful in-line use of the technology in cleaning and coating processes include the layerwise removal of organic coatings, stripping or partially removing metallised coatings prior to adhesive bonding, the production of car headlights or the treatment of reflectors. The main objectives in all of this are to achieve savings in material and process costs and the possibility of achieving environmentally compatible bonded joints.

The precision pretreatment and ultrafine cleaning of surfaces to be bonded by means of Openair plasma allows the use of both modern solvent-free UV adhesives and water-based systems. "Thus, for example, polycarbonate windows can be glued into the housing half shells of mobile telephones using solvent-free UV adhesives" notes Christian Buske. "But equally well casein-based adhesives can be used for labelling plastic containers."

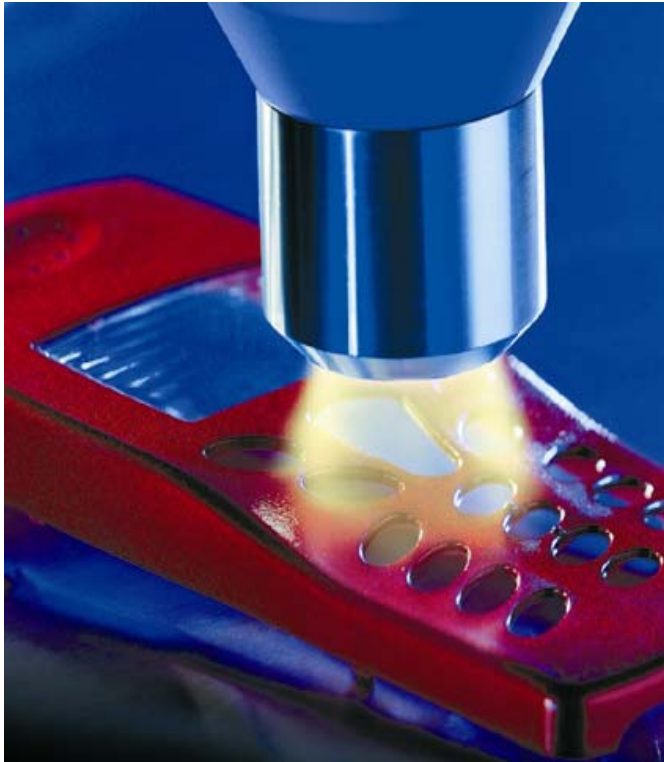
Secure bonding of aluminium alloys

Although the bonding of aluminium is now state of the art, considerable effort is needed in conventional pretreatment methods to durably bond the surfaces to resist the effects of corrosive media such as moisture and salt. Wet-chemical methods such as chromating or anodising are usually employed to meet the high requirements. These, however, are cost-intensive batch processes which in addition are highly dubious in ecological terms.

Different aluminium alloys can be reliably bonded by means of Openair plasma. For this purpose the surface is finely cleaned by the jet system and at the same time its oxide structure is modified. If special corrosion protection is needed the surfaces may also be coated with a diffusion-tight and readily bonded plasma polymer layer. Since the plasma process is capable of in-line installation without restriction and is compatible with robots it can be used for cleaning sheet material in the coil coating process and also for cleaning profiles or for the corrosion-resistant coating of housing flanges. Suppliers to the automotive industry use Openair plasma to protect highly sensitive electronics such as sensors and control elements. In order to obtain the best possible seal in protective housings made of plastic or aluminium in modern production processes the surfaces to be joined are treated with plasma before the adhesive is applied. "The pretreatment cleans and activates the housing surfaces so well that now as a result of their enhanced adhesive properties the subsequent bonded joint provides a high degree of protection against the penetration of harmful influences" explains Buske. "The risk of short circuits, malfunctions and possible destruction is eliminated."

The surfaces of non-polar plastics are difficult to wet. Accordingly, water-based adhesives and paints, modern ones in particular, must be activated by pretreatment before they are applied. In the automotive industry pretreatment with Openair plasma is specifically used in the installation of headlights. In this case the process ensures a firm diffusion-tight adhesive joint and hence a secure seal against the penetration of moisture. In the case of air-bag covers made of PU Openair plasma treatment not only ensures the adhesive joint but also removes thoroughly the residues and additives left over from the injection moulding process.

Plasma coating is a process that up to now could only be carried out in vacuo. With the aid of the Openair technology combined with a newly developed way of feeding in precursor material this is now possible at atmospheric pressure. The precursor is a volatile reaction material which after treatment remains as a coating on the base material. The advantages of this technique can now be used also for coating plastics. Apart from technical advantages the process also offers economic advantages. It allows considerable savings in material costs since now, for example, instead of costly cycloolefins low-cost polycarbonates can be employed.



Inès A. Melamies
Technical journalist in Bochum

Openair plasma cleans the surface in ultrafine fashion prior to painting. In this way polycarbonate windows can be glued using solvent-free UV adhesives into the housing half shells of mobile telephones
Photo: Plasmamatreat