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TREND SETTING CORROSION PROTECTION

PLASMA ALLOWS NANOCOATING OF ALUMINUM UNDER NORMAL PRESSURE

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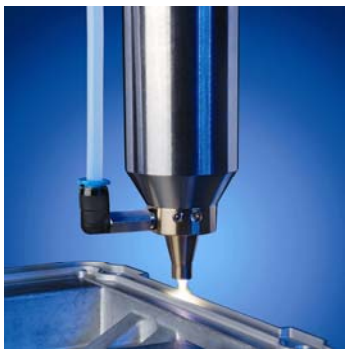
What was until recently only possible in a vacuum can now be achieved in-line under normal atmospheric conditions: a plasma technology by the name of PlasmaPlus offers an abundance of different functionalised coatings for the selective coating of material surfaces.

The basis of the process is the Openair atmospheric-pressure plasma technology from the Germany based Plasmatreat GmbH. The plasma-jet technique developed by today's market leader has been used



throughout the world for over 15 years in the most varied industries.

The zero-potential plasma system is characterised by a three-fold action: it activates surfaces by selective oxidation processes, discharges them at the same time and brings about microfine cleaning and high activation of the surfaces of metals, plastics, ceramics and glass. Its intensity is so high that treatment rates of several 100 m/min can be achieved. In addition, the plasma energy of this system is exploited for film formation.

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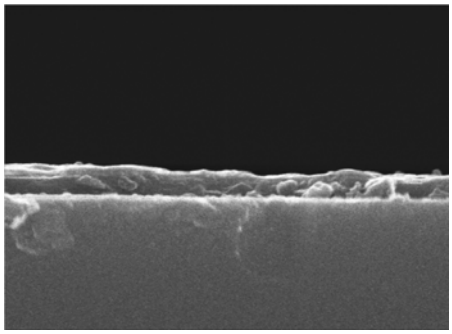

Cross Section through an approximately 100 nm thick Openair PlasmaPlus layer @ 500x magnification

From the economics point of view the jet systems used can always be integrated in-line by the user, that is to say integrated directly into a new or already existing production line. Scarcely any bounds are set to the versatility of application of the eco-friendly technology. Conventional pretreatment methods such as cleaning using wet chemicals are completely displaced by the high quality plasma process and certain working steps are rendered unnecessary. This gives rise to significant cost savings in production workflows.

Until recently plasma coating used to be a process that could only be carried out in vacuum. In close collaboration with the Fraunhofer Institute IFAM in Bremen Plasmatreat developed a new process by the name of PlasmaPlus which for the first time allowed nanoscale thin films to be applied to the surfaces of materials at atmospheric pressure. As a world premiere this plasma polymerization process was brought to industrial application by Plasmatreat in 2007 by coating engine pump housings for steering units against bondline corrosion at TRW Automotive.

PLASMA POLYMER ISATION UNDER NORMAL PRESSURE

To produce a layer the atmospheric-pressure plasma employed here is admixed with an organosilicon compound. Due to the high-energy excitation of the plasma this compound is fragmented and is deposited on a surface in the form of a vitreous film.

The chemical composition can be varied according to application in order to achieve the best results for the different materials

involved. To evaluate the thicknesses of the layers SEM (scanning electron microscope) studies were carried out.

At 50,000 times magnification scanning electron micrographs of coated sample cross-sections reveal a homogeneous and non-porous layer structure. This is very important in corrosion protection since we are dealing here with a passive layer, which means that attack by corrosive media is prevented due to a barrier effect. The material in the coating itself is not sacrificed during the corrosion process, as would be the case, for example, in a zinc-coated or galvanised steel surface (active corrosion protection).

PROTECTING AL UMINIUM AGAINST CORROSION

Apart from its in-line use, the great advantages of 'PlasmaPlus' technology compared with other coating techniques lie primarily in the technique of selective coating.

The anticorrosive action is particularly effective in aluminium alloys. The coating is able to protect the aluminium for several days against direct salt spray fog (DIN 50021) without the visual appearance of the metal being affected. To demonstrate the mode of action an aluminium plate (Al 99.5) was partially coated, while the remaining area was left in the unprotected initial state. After 96 hours of exposure to the salt spray test the uncoated aluminium surface was highly corroded (matt area) while the coated area still exhibited its original lustre. The boundary between the corroded and uncorroded areas is clearly discernible in the photomicrograph at 100 times magnification. If plasma coating is used for corrosion protection a thick layer (several hundred nanometres) is advisable since this is more resistant to corrosive media, such as electrolyte solutions, acids and alkalis. When the layer is used as a bonding agent just a few nanometres suffice in principle since this thin film comprises all the important functional groups with which the adhesive can react and undergo strong bonding.

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