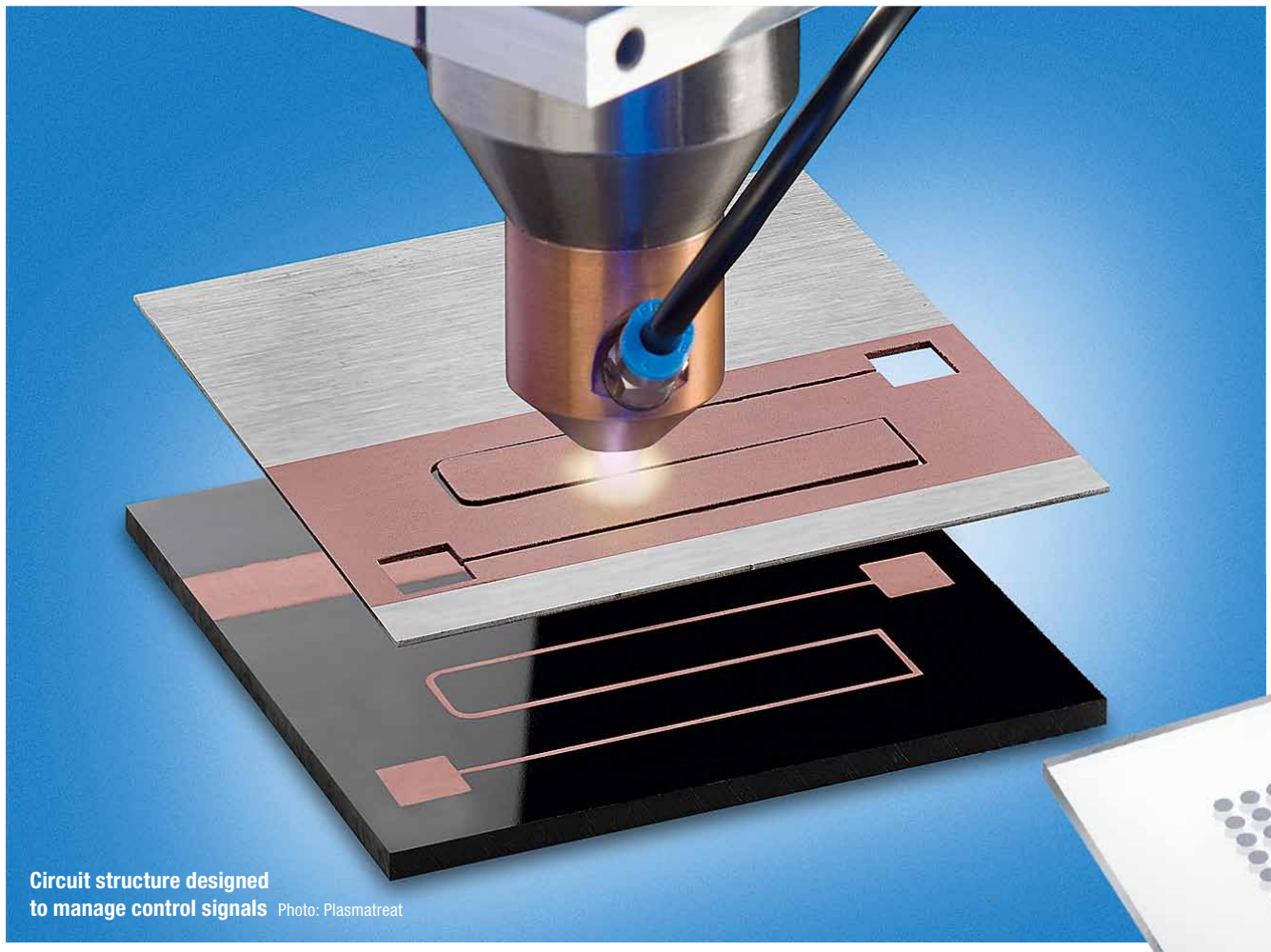
Electrifying technology

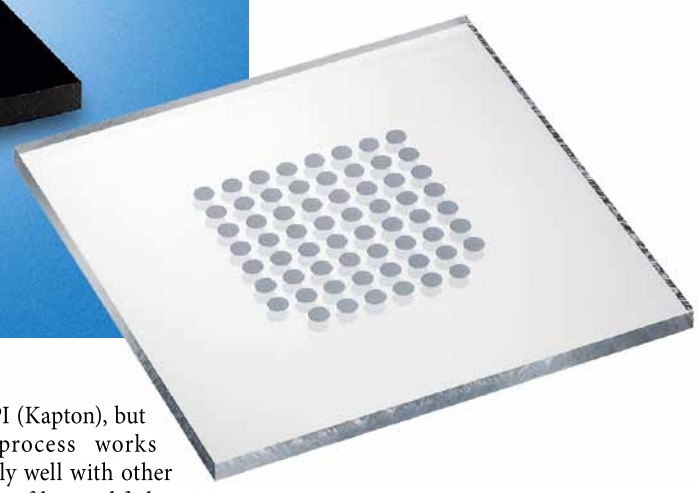
Atmospheric plasma thin-film technology makes plastics conductive

Plasma technology. Be it conductive traces, electromagnetic shields or adhesion promoting coatings, a metallic fine-powder thin film applied with atmospheric plasma confers entirely new, functional characteristics on plastics. Fast, environmentally friendly and millimeter-precise.

The FPC (Fine Powder Coating) plasma process differs distinctively from conventional methods. Not only does it pre-clean and activate substrates in a single, environmentally-friendly operation; it also produces functional metallic coatings in a matter of seconds. The process represents a product which has been jointly developed by Plasmatreat GmbH in Steinhagen and Efc Plasma GmbH in Ingolstadt.



Circuit structure designed to manage control signals Photo: Plasmatreat



Design flexibility: A pattern of aluminum dots applied to Plexiglas using the FPC plasma process to scatter light in a vehicle interior.
Photo: Plasmatreat

The 4th state of matter

Plasma is based on a simple, physical principle. States of matter change when energy is applied. When more energy is applied to a gas, it becomes ionized and the electrons receive more kinetic energy and leave the shell. This gives rise to free electrons, ions and molecular fragments, transforming the gas into the state of plasma. But under atmospheric pressure this "4th state of matter" can hardly be used due to its instability. Almost 20 years ago Plasmatreat succeeded in integrating plasma in-line into production processes thereby making its use under normal ambient air conditions entirely feasible on an industrial scale. The plasma process is fully compatible with robotic applications and since the nozzles are operated solely with air and high voltage, it is environmentally friendly. Christian Buske, CEO of the Plasmatreat Group explains: "The emitted plasma beam is electrically neutral, a special feature which greatly extends and simplifies its applicability. It has such high intensity that processing speeds of several hundred meters per minute can be achieved during the pretreatment of materials." The plasma system has a threefold action: it cleans surfaces to a microfine level, activates them by selective oxidation processes and at the same time discharges them. The safe, reliable and reproducible plasma treatment process can entirely replace conventional pretreatment methods, thereby avoiding harmful emissions and reducing the number of process stages. This results in significant cost savings and high environmental compatibility.

How FPC works

The FPC plasma coating process has three principal components: the powder, the powder delivery system and the plasma system. Openair plasma technology performs several tasks simultaneously. Firstly, microfine cleaning and activation of the material surface in preparation for coating is performed by a robot-controlled plasma nozzle. Immediately after the pretreatment the coating is applied. For this purpose the robot guides a dedicated second plasma generator, in which the plasma functions as a safe and rapid transport medium for the powder heated within it. Microfine powders comprising aluminum or tin, copper, zinc, nickel or different alloy systems, custom blended for plastic coatings, are injected directly into the highly energized arc. The metal particles absorb the electrical and thermal plasma energy. The high-density plasma melts the particles which then fuse to form a layer. Assisted by sophisticated fluid mechanics, the process gas gently transports the particles to the substrate to produce a homogeneous metallic coating. Compared with thermal spray processes, FPC coatings are not only far thinner and more compact, they have a significantly smaller oxide concentration. Subsequent drying or curing stages, as is the case with galvanizing or aerosol methods, become unnecessary. The component can be processed immediately after coating.

Locally selective coating

A particular advantage of the fine-powder coating plasma process, apart from its inline capabilities and speed, is its locally selective application: in contrast to spraying or dipping bath processes, the robot-controlled fine plasma nozzle applies coatings with millimeter precision. The characteristics of Openair plasma technology ensure that thermal loading is extremely low. The process uses fine metal powders to coat thermally sensitive plastics, thereby rendering them conductive and solderable without the use of wet chemicals. It is even possible to make them thermally conductive. Coatings for electronic applications are applied mainly to plastics like ABS, PMMA, PA, GFK, PEEK and PI (Kapton), but the process works equally well with other plastics, films and foils as well as woven and nonwoven materials. "The quality of the coatings and thus the success of the process depend on ensuring that the powder, powder delivery system and plasma technology are 100% compatible," states Willy Speth, managing director of Efc Plasma. The process has aroused a great deal of interest. The competence center for metallic thin-film technology opened just a few months ago by Plasmatreat and Efc plasma in Allershausen, Bavaria, has already generated enquiries from a number of different fields including the automotive industry, the wind and solar industry, drive technology, motor and mechanical engineering, medicine and electronics. Fitting copper conductive traces to polyamide washing machine panels to manage control signals, or coating Plexiglas with aluminum dots to create an exclusive light-scattering film to illuminate car interiors; applying a functional coating to plastic enclosures to provide EMC shielding or a structured layer to components to promote adhesion and facilitate subsequent galvanizing – the process offers virtually unlimited flexibility with regard to configuration, application and material. Patented friction-enhancing or corrosion protection layers can be applied to metals; a technique which the FPC center in Allershausen has already applied to small production runs of special toll-manufactured vehicle components for German car manufacturers.

Featuring in-line capabilities, high process speeds and layer deposition with pinpoint precision, this pioneering FPC technology occupies a niche between conventional low-pressure plasma techniques and thermal spray processes. Reliable, environmentally friendly and efficient, this process is equally suitable for low or high volume production runs.

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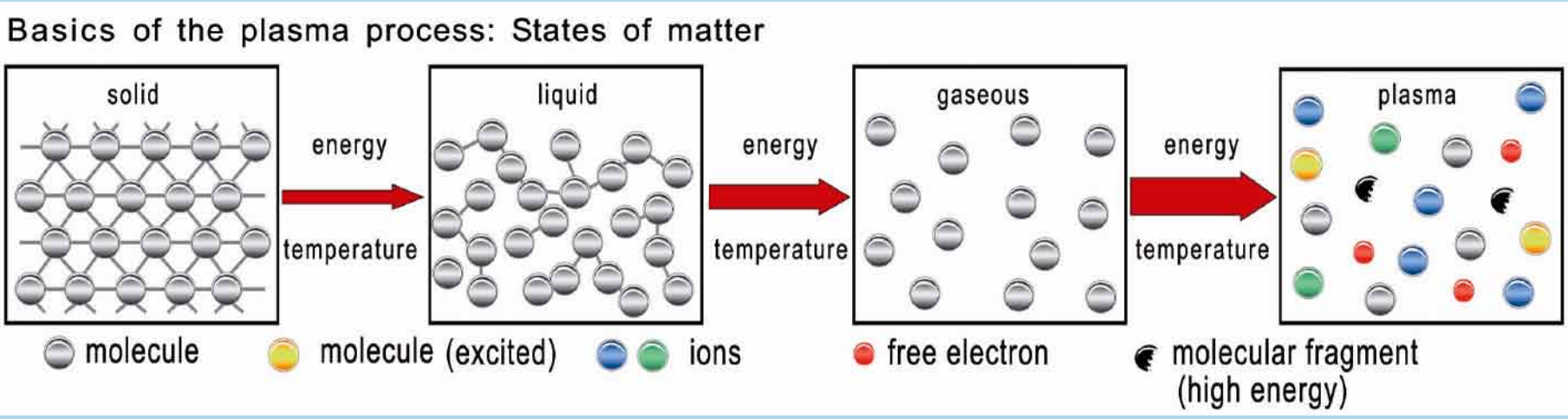

Generating plasma Diagram: Plasmatreat