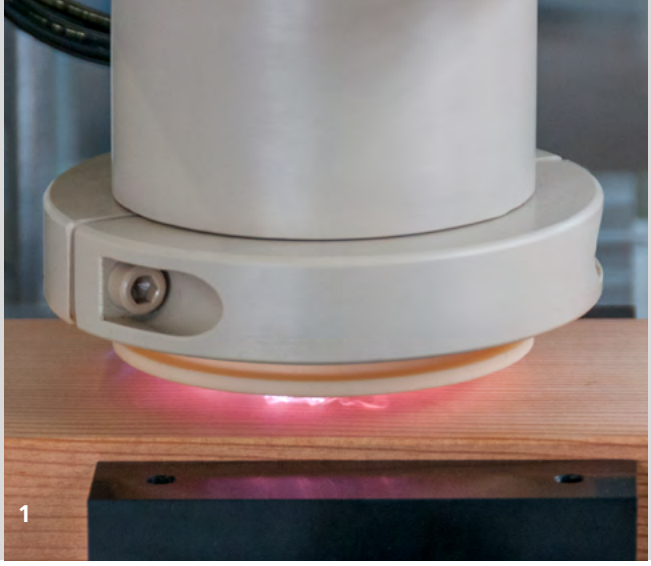

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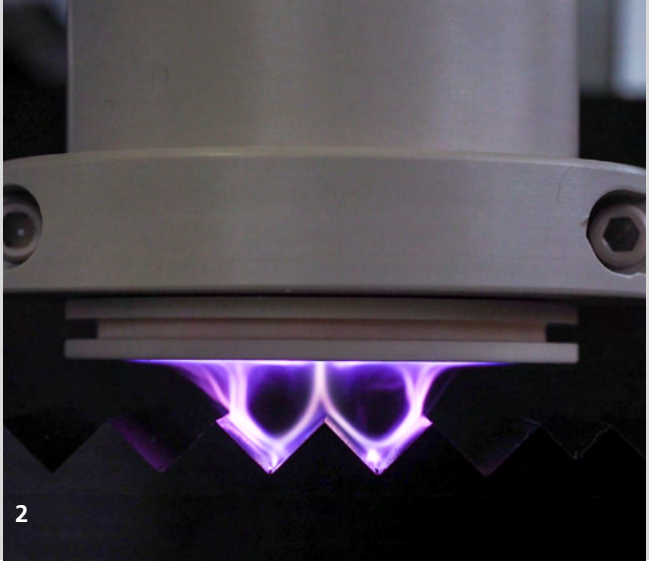

2

COMPACT JET-INDUCED SLIDING DISCHARGE SOURCE

Commercially available atmospheric-pressure plasma sources are today already being utilized in the most diverse sectors and areas of industry for the cleaning and activation of surfaces. Through the application of plasma processes, it is possible for e. g. paints and adhesives to adhere to surfaces without chemical pre-treatment. This saves costs and is environmentally friendly. Depending on the field of application, effective solutions for the activation, functionalization, ultra-fine cleaning or coating of surfaces are available, ranging thereby from laminar pre-treatments such as corona activation for sheet goods to the partial treatment of three-dimensional components with plasma jets. The plasma treatment of laminar and simultaneously partially complex geometries, such as deep-set slots, cavities or undercuts does, however, pose a particular challenge. Costly array arrangements with plasma jets or complicated combination solutions are often unavoidable here. At the Fraunhofer IST, a plasma source concept based on a jet-induced sliding discharge has been developed which enables the effective activation or functionalization of even geometrically challenging contours.

The functional principle

Inside the sliding discharge source, a cold plasma on the basis of a dielectric barrier discharge (DBE) is initially ignited by means of alternating voltage. As shown in Figure 3, this is driven out of the center of the nozzle by the process gas flow and strikes the substrate surface. Here, sliding discharges in the form of long plasma filaments develop towards the earth electrode on the underside of the plasma source. These plasma filaments affect the substrate surface along its contour. This process enables a uniform and comprehensive treatment of surfaces, including possible indentations or cavities. Depending on the source execution and the distance from the source to the substrate (1–40 mm), effective treatment widths of between 10 and 120 mm are available.

A very good alternative to wet chemistry

The plasma source concept was developed within the framework of a publicly funded project as an alternative for wet-chemical primers in the preliminary stages of painting and laminating processes on PVC extrusion semi-finished products. As the ambient air in the treatment area is virtually completely displaced, the jet geometry furthermore ensures very homogeneous and reproducible treatment effects – largely independent of the prevailing ambient conditions – and enables, depending on the discharge distance, the utilized process gas and the specific plasma parameters, a very precise adaptation of the surface energy of the substrate to the medium which is to be applied, e. g. paint or adhesive system. Very efficient results have been achieved on PVC as well as on all other common polymer materials.

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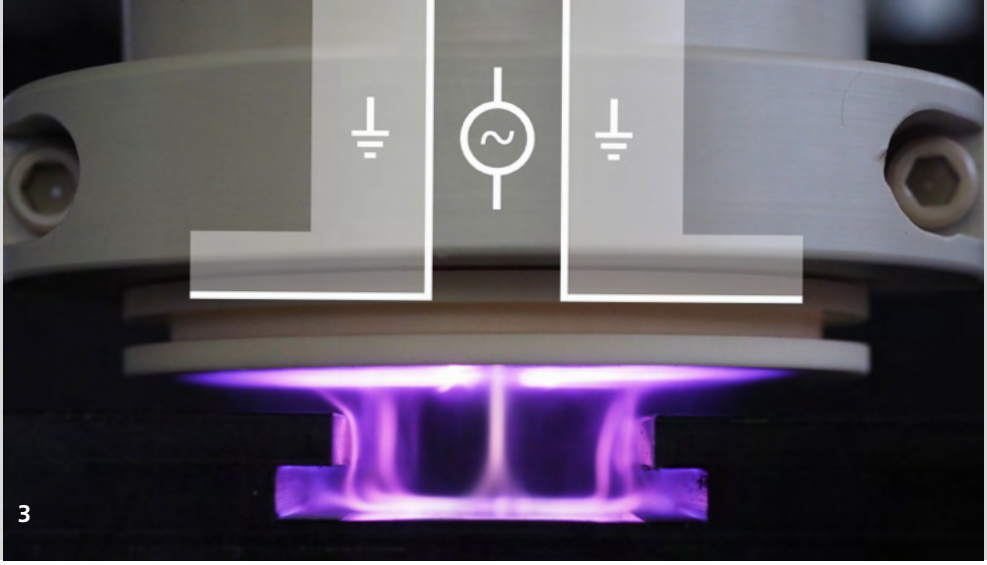
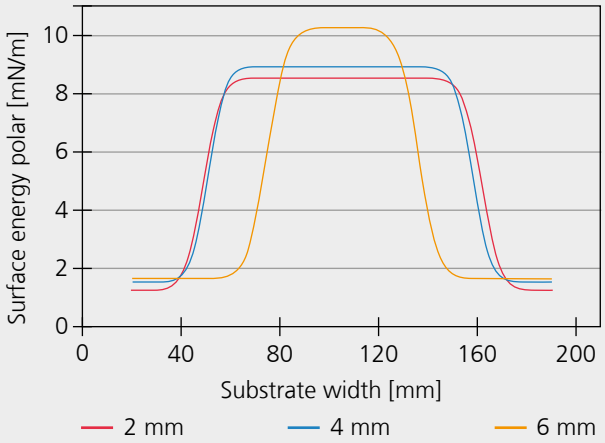


1 *Laminar sliding discharge under exclusion of ambient air in a defined process environment.*

2 *Surface treatment of a gear rack.*

3 *Discharge characteristics and functional principle of the sliding discharge plasma jet during the surface treatment of a T-slot.*



Effective discharge widths of the plasma jet determined by the change in the polarity of the surface in dependence on the substrate distance.

Outlook

In close collaboration with industrial partners, the plasma source concept developed at the Fraunhofer IST is to be transposed into a practicable commercial solution in the future in order to provide a decisive contribution towards sustainable and environmentally friendly production processes.

The project

The described results were achieved within the project "Neuartiges Plasmakonzept zur Oberflächenfunktionalisierung von Polymer-Extrusionshalbzeugen bei Atmosphärendruck unter Vermeidung von gesundheitsgefährdenden Stoffen – KF 2004825DF4" (Innovative plasma concept for the surface functionalization of polymer-extrusion semi-finished products at atmospheric pressure under the avoidance of hazardous substances - KF 2004825DF4), which was funded by the German Federal Ministry for Economic Affairs and Energy (BMWi).

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