Low-cost high-quality plasma cleaning and activation of large size flat surfaces

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Over the past two decades, plasma surface treatment techniques of polymeric web materials (textile materials, paper, polymer films) and large size flat materials as architectural glass, wooden desks, etc. have been extensively reported both in open as well as patent literature. Apparently the most significant advantage of the non-thermal plasma surface treatments is that they are usually fast and affects about 10 nanometers of the uttermost surface layer. Accordingly, using the plasma surface activation, the surface functionalities and characteristics can conveniently be tailored on a nanometer scale.

The vast majority of such plasma have been made at reduced pressures on the order of 10^{-3} - 10^{3} Pa , where the low-temperature plasma can easily be generated and brought into direct contact with the treated surfaces. However, the use of expensive vacuum systems that force batch processing has discouraged these applications, where on-line surface treatments of products with the low added value in large amounts are required.

As a consequence, the development of atmospheric pressure plasma sources to replace plasma processing in vacuum system is a current trend in industrial plasma engineering [1]. A common shortcoming of a great majority of atmospheric pressure plasma sources applied for surface treatments and plasma depositions is that a helium-containing plasma gas is required to prevent the appearance of filaments or sparks that are detrimental to the treatment uniformity and can lead to the undesirable plasma thermalization.

Collaborating Czech and Slovakian university teams have recently developed an innovative plasma source, the so-called Diffuse Coplanar Surface Barrier Discharge (DCSBD) [2-3], which has the potential to move a step closer to the industry requirements. The idea is to generate a thin (on the order of 0.1 mm) layer of plasma with a high power density in the immediate vicinity of the treated surface and bring it into a close contact with the treated surface. Comparing with other atmospheric-pressure plasma sources as the so-called coronas, plasma jets and APGDs, diffuse plasma layers generated by DCSBDs provide substantial advantages in energy consumption, exposure time, safety, and technical simplicity (see, Fig. 1 and Refs. 4,5).

The patent-protected applications of DCSBD for the plasma activation of textile materials, polymer films, metal surfaces, flat glass and wood [6], illustrating unique properties of the DCSBD plasma technique will be discussed in details.

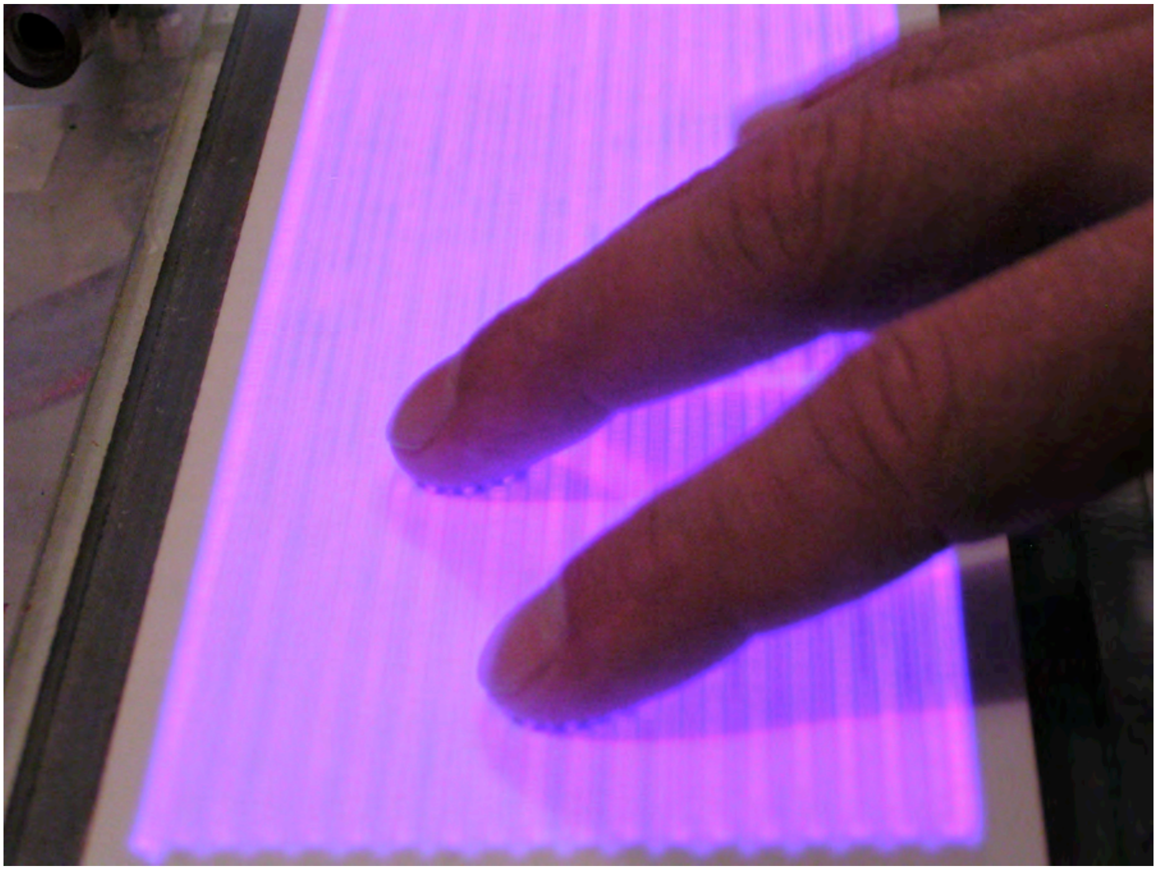

Figure 1. Despite of an extremely high plasma power density (~ 100 W/cm^3) and hight electron temperature (~ 10^4) the ambient air DCSBD plasma is safe in contact with human body.

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