

Advances in Industrial and Biomedical Applications of Atmospheric-Pressure Plasma Jets

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In this paper, we describe many advances in industrial and biomedical applications of various kinds of atmospheric-pressure plasma jets (APPJs) in our research group. These 10-30 kHz APPJs use different kinds of electrode designs and discharge gases including helium, argon and nitrogen, which can be mixed with oxygen for different applications. For the industrial applications, we have applied APPJs for fast surface modifications for different purposes, which may include improvement of hydrophilicity of various kinds of surfaces that could be either polymer or metal. In addition, a novel round APPJ processing system is presented for efficient and direct blind-hole treatment of flexible printed circuit, in which there is no need for vacuum processing and wet chemical treatment, unlike conventional treatment method. For the biomedical applications, many examples are presented. They include improvement of biocompatibility of planar and honeycomb structured PLA surfaces, sterilization of many kinds of bacteria and endospore, wound healing enhancement of acute and insulin abundant mice, skin improvement through plasma treated water, blood coagulation, porcine bone sterilization, treatment of gray and green nails, tooth bleaching and possible improvement of pulp stem cell differentiation, to name a few. At the end, a typical APPJ modeling is presented to illustrate its complex physics and chemistry involved.