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Atmospheric pressure plasmas for surface processing

A plasma is useful for industrial and material processing due to high treatment effects and environmental compatibility. Surface modification for adhesion improvement is among the most promising applications for plasmas. Practically it is realized by introducing electrical energy to a gas to generate a plasma as a reactive gas, in which a material surface is exposed. During plasma
surface treatment, addition of polar functional groups, roughening, and removal of weak domains can take place simultaneously. All of them are important to improve adhesion by better interaction with adhesives or uncured polymers in composite manufacturing. For many practical applications, atmospheric pressure plasma processing is more preferable than low pressure plasmas, as it can avoid to use expensive vacuum systems.
Here, newly developed atmospheric pressure plasmas for surface processing are presented; a gliding arc and ultrasound enhanced plasma processing. The gliding arc is characterized by stable extension of the discharge into air up to several centimeters operated by a high frequency alternating current (AC). In the optimized conditions, highly oxidative radicals are efficiently produced and used for surface processing. In addition, the discharge may not necessarily extinguish at every half period, but can survive over a plurality of AC periods, suppressing unwanted energy consumption for discharge ignition. Ultrasound enhanced plasma processing demonstrated enhanced treatment effects, arc suppression, and improved treatment-uniformity, compared to plasma processing without ultrasonic irradiation.

Primary author: KUSANO, Yukihiro (DTU Wind Energy)

Presenter: KUSANO, Yukihiro (DTU Wind Energy)