# ATMOSPHERIC PLASMA SURFACE MODIFICATION OF 1100 AND 7075 ALUMINUM ALLOYS: AN EVALUATION OF THE ADHESION PROPERTIES

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## 1. Introduction

Aluminum alloys are widely employed in many industries because of their beneficial mechanical properties. However in the most applications aluminum alloys should first undergo an initial surface processing, such as, cleaning or activation. The chemical pre-treatments, which are frequently used for those purposes, are not environmentally friendly due to the production of hazardous by-products. Nowadays, atmospheric pressure plasma treatments have emerged as an alternative method for materials surface modification because they are relatively cheap, easy to scale-up and do not generate wastes into the environment [1]. To improve adhesion properties of 7075 and 1100 aluminum alloys this work deals with plasma surface modification using two different atmospheric plasma sources – atmospheric pressure plasma jet (APPJ) and dielectric barrier discharge (DBD).

## 2. Experimental Setup

First experimental arrangement employed to treat aluminum samples was an APPJ terminating with a horn-like nozzle that is schematically presented in the Fig. 1. In this case an AC power supply operating at 19 kHz frequency and voltage amplitude of 12 kV was used to generated plasma (see Fig. 2). The jet was fed with argon and the samples were exposed to the plasma for 20s, 30s, 40 s and 60s. In the second case a classical DBD configuration in planar geometry was used. Plasma was generated by a line power supply (60 Hz) and the applied voltage was 30 kVpp. Samples were exposed to air-DBD plasma for 5 min, 7.5 min, 10 min e 15 min. After treatments, characterization of AA7075 and 1100 alloys surface was performed by water contact angle and surface free energy measurements, roughness assessments, adhesion tape test [2] and FTIR analysis.

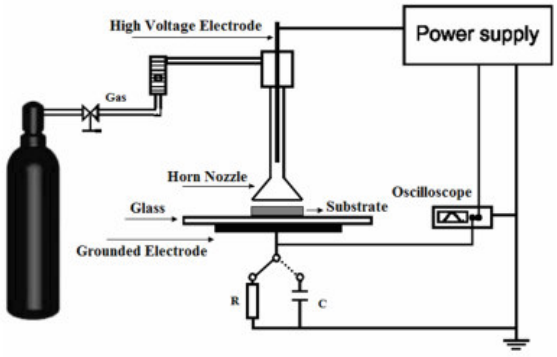


**Fig. 1.** *Experimental setup used for surface modification.*

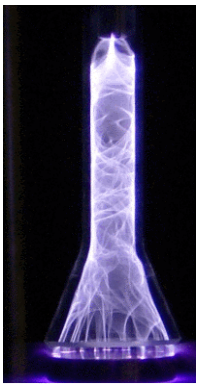

**Fig. 2.** *Close view of APPJ with a horn-like nozzle.*

## 3. Results and Discussions

After both plasma treatments, there was a remarkable decrease in water contact angle values and a significant increase in surface free energy (~2.5x) for the two aluminum alloys. It was also observed that the plasma treatments did not modify the samples morphology. The adhesion tape test results proved that both plasma treatments were efficient in improving the adhesion of polyurethane coating on the aluminum alloy samples when compared to the untreated ones. The FTIR analysis demonstrated that the plasma treatments cleaned the Al alloy surface by removing hydrocarbon contaminations. The atmospheric pressure plasma treatments were more efficient in enhancing adhesion of polyurethane painting on the AA7075 samples than that on the AA1100 surface. In conclusion the enhancement of Al alloys adhesion properties was caused samples surface cleaning promoted by the plasma treatments.

## 4. References

[1]- J. Winter, R. Brandenburg and K.-D. Weltmann, Plasma Source Sci. Technol., 24, 064001, (2015).
[2]- ASTM D3359-07, Standard Test Methods for Measuring Adhesion by Tape Test, 1–7 (2013).

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