Topic number: 4

INFLUENCE OF ATMOSPHERIC-PRESSURE PLASMA TREATMENT OF ALUMINIUM SURFACE ON THE DIFFERENT ORGANOSILANE COATINGS

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Aluminium alloys are known for their high strength-to-weight ratio and high durability and these properties give them an important role in the aircraft and automobile industries; however it is a significant part of other industrial branches, such as microelectronics, modern buildings and high quality packaging. Apart from that aluminium has excellent electrical and heat conductivities.

The bonding of organosilanes to aluminium surfaces has considerable interest both for adhesion promotion and for corrosion protection [1]. The adhesion property of the silane on aluminium depends on chemical bonding at the silane-aluminium interface and weaker physical bonding. The critical step in the bonding process is the cleaning of the aluminium substrates prior to the film deposition. According to many works, alkaline cleaning seems to be the best pretreatment before the application of silanes [2]. However, these wet-chemical treatments are problematic under environmental consideration because of the disposal of damage waste in the treatment baths. Nowadays alternative plasma technology is an object of great interest. Therefore the non-equilibrium atmospheric-pressure plasma treatment seems to be a suitable alternative to the wet chemical methods. These types of non-thermal plasmas have recently received increased attention because of their use in environmentally friendly technology for various applications. Also in the industry producing metallic plates and foils the treatment of surface by non-equilibrium plasma could be a solution for ecological and low-cost in-line processing.

The paper will present results on a novel atmospheric-pressure ambient plasma cleaning and activation of aluminium surfaces based on the use of Diffuse Coplanar Surface Barrier Discharge (DCSBD) [3]. The DCSBD plasma sources generate thin (~ 0.5 mm) layers of diffuse non-equlibrium plasma of an extremely high plasma power density of some 100 W/cm^3, which results in plasma cleaning times on the order of one second.

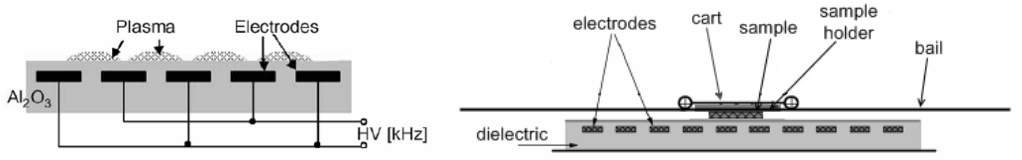

Fig. 1: Scheme of the DCSBD discharge with electrodes and the drawing of a sample treatment in dynamic mode

This type of non-equilibrium plasma source was already successfully tested for on-line plasma activation and modification of surfaces of nonwoven textile [4], wood [5], glass [6] .

Aluminium plates (99.5% Al) and anodized aluminium plates were used as the samples. The surface of the plasma treated aluminium samples were hydrophilic after very short treatment time (3 - 5 s), which was tested by contact angle measurement. Different types of silanes (1,2-Bis(triethoxysilyl)ethane, Trichlorooctadecyl-silane and (3-Aminopropyl) Triethoxysilan) were used to created a thin layer on the aluminium surface.

The properties of silane coated aluminium samples were analyzed by SEM, EDX, FTIR and contact angle measurements. The permanency of silane layers was tested as well by boiling water test. By comparing the results of silane coated aluminium samples a difference between plasma treated and untreated ones was investigated. The preliminary results indicate that this novel atmospheric-pressure plasma source may be useful for the cleaning, activation of the aluminium surface and silane layer preparing.

Acknowledgements

This research has been supported by the Grant APVV-0491-07 from Ministry of Education of the Slovak Republic, Aim Project MSM0021622411 and Grant UK/415/2009.

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