## Surface Roughening of Aluminum Substrate for Resin Adhesive by Atmospheric Pressure Plasma Jet

大気圧プラズマジェットを用いた樹脂接着用アルミ基板の表面粗化

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## 1. Introduction

In recent years, aluminum material is widely used in numbers of the transportation equipment products for weight promotion. Decrease in vehicle weight, leading to limited energy consumption, is one of the most important challenges in the field of modern transport. Similarly, a resin material is

also light, and demands of the lightweight are also high. So, in the recent years, the resin material applications are expanding. Adhesive technology of aluminum and resin has been required along with it. Conventionally, wet process treatment (using chemicals to improve adhesion with resin) has been used. However, there are many problems to take a cost and to cause damage to the environment by waste liquid. As a dry process to treat the surface, plasma has attracted more attention. the Atmospheric pressure plasma used in the present study has a high reproducibility and it is suitable to continuous processing. Furthermore there is an advantage that the vacuum apparatus is not needed and disposal device is capable of processing at a low cost and simple apparatus configuration. In this research, we reported the surface roughening of aluminum substrate for resin adhesive by He atmospheric pressure plasma jet (APPJ) added to pure water vapor.

## 2. Experimental setup

The schematic diagram of the experimental setup is shown in Fig.1. We produced atmospheric pressure plasma jet by setting ring-shaped electrode of copper to the quartz tube, and applied to the RF power (200 W) and the high frequency (13.56 MHz). The outer diameter of the quartz tube is 6 mm, and inner diameter is 4 mm. We compared with two experimental conditions, where we used only He gas (950 sccm) in the case 1, and we used He gas with pure water vapor mixture gas (total gas flow is 1000 sccm with 50 sccm by bubbling of H<sub>2</sub>O solution) in the case 2.





## 3. Result

"Atomic Force Microscope" (KEYENCE factory VN-8010) was used for measuring surface roughening of aluminum substrate. We treated the aluminum surface by plasma jet for 4 samples (untreated, 1 min, 5 min, 10 min treated by He and H<sub>2</sub>O gas mixture plasma jet) were prepared and compared. The result of surface roughening of aluminum substrate experiment is shown in Fig. 2. We confirmed that surface roughening of aluminum substrate is significantly increased by treating plasma jet.



Fig.2 Surface roughness versus processing time.