DEVELOPMENT OF 335 mm LINEAR-TYPE ATMOSPHERIC PLASMA SOURCE FOR SURFACE TREATMENT

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In recent years, atmospheric plasmas have been widely used for industrial applications such as surface treatment, CVD, elemental analysis and decomposition of hazardous wastes. Atmospheric plasma sources do not require vacuum chamber or pumping system and can generate high density plasma. In addition, non-equilibrium atmospheric plasmas, which have much higher electron temperature than gas temperature, have recently attracted much attention because these plasmas do not damage to the target material.

In our research group, from 100 to 250 mm long linear-type atmospheric plasma sources were designed and developed for surface treatment application. Argon or helium can be used as the plasma gas. Oxygen, nitrogen or some of other gases can be mixed up to 10% to enhance an effect to surface treatment. The RF power is applied to the electrode in the plasma source, and the body of the plasma source is grounded. The plasma source has a 1 mm wide slit flowing out plasma with these gases. One of the special features of our plasma source is “damage free” which means few risk of discharge damage to target materials. This plasma source has low temperature (room temp. to 430 K). Therefore, our plasma source can be applied to not only silicon wafers, but also metals, plastics, papers, textiles, human skins and other materials which were impossible to apply before.

We used this plasma source for hydrophilization of metal surface. 950 mm/sec of the maximum hydrophilization speed was achieved at 700 W of RF power and 10.5 % of oxygen concentration rate to helium plasma gas. We measured oxygen emission intensity and an excitation temperature through the hydrophilization process with spectroscope, and we found oxygen emission intensity was strongly related with the processing speed.

In this study, we also designed and developed a 335 mm long linear-type handy plasma source. This plasma source will be applicable for surface treatment of plastics, textiles, papers or 12-inch semiconductor wafers. Fundamental properties of the plasma source such as experimental conditions, treatment speed and emission properties will be presented.