

PF-003

Development of an advanced atmospheric pressure plasma source with high spatial uniformity and selectiveness for surface treatment

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In the last few decades, attention toward atmospheric pressure plasma (APP) has been greatly increased due to the numerous advantages of those applications, such as non-necessity of high vacuum facility, easy setup and operation, and low temperature operation. The practical applications of APP can be found in a wide spectrum of fields from the functionalization of material surfaces to sterilization of medical devices. In the secondary battery industry, separator film has been typically treated by APP to enhance adhesion strength between adjacent films. In this process, the plasma is required to have high stability and uniformity for better performance of the battery. Dielectric barrier discharge (DBD) was usually adopted to limit overcurrent in the plasma, and we developed the pre-discharge technology to overcome the drawbacks of streamer discharge in the conventional DBD source which makes it possible to produce a super-stable plasma at atmospheric pressure. Simulations for the fluid flow and electric field were parametrically performed to find the optimized design for the linear jet plasma source. The developed plasma source (Plasmapp LJPS-200) exhibits spatial non-uniformity of less than 3%, and the adhesion strength between the separator and electrode films was observed to increase 17% by the plasma treatment.

Keywords: plasma, dielectric barrier discharge, surface treatment, secondary battery, linear source

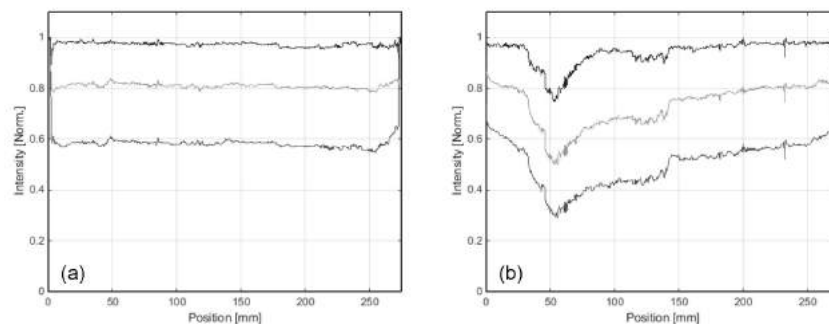


FIGURE 1. UV exposure film treatment profiles of each color coordinates (R: red, G: green, B: blue) obtained at (a) an uniform and stable plasma and (b) unstable plasma of LJPS-200

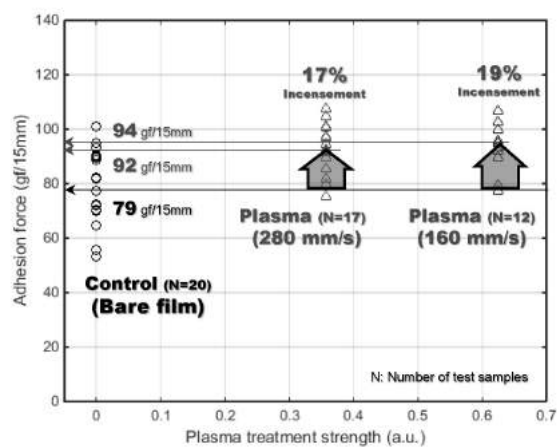


FIGURE 2. Adhesion strength of (a) the untreated separator film (black circles) and separator films treated at different line speeds of (b) 160 (blue triangles) and 280 mm/s (red triangles)

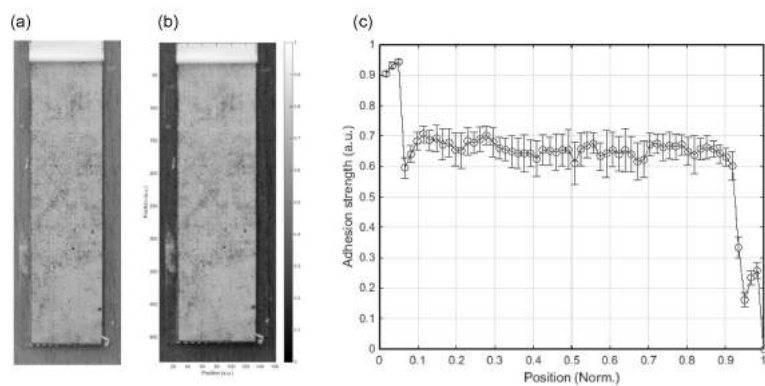


FIGURE 3. (a) Image of the electrode film from which the separator film is detached, (b) blue color coordinate profile of the image, and (c) an adhesion strength profile estimated from the white trails left on the electrode film