Reduction-Phase-Time Dependence of Atmospheric-Pressure-Plasma Nitriding for Stainless Steel

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Stainless steel has excellent corrosion resistance and is used in many industries. In order to improve mechanical properties of stainless steel, we are studying the nitriding treatment using atmospheric-pressure-plasma jet for stainless steel as our unique technology. It is necessary to reduce the passive film to perform nitriding stainless steels. We found that N atoms can be diffused into the sample by adding H_2 gas to the N_2 operating gas [1]. As a new method, the process divided into a “reduction phase” in which 5% of H_2 is added to increase efficiency of reduction of the passive film and “nitridation phase” in which H_2 is reduced to 1% to increase the NH density. We expect that the thickness can be increased by performing this two-step process as compared to the conventional nitriding process of the nitridation-phase only. In this research, we investigated the reduction-phase-time dependence of N_2 diffusion into stainless steel.

Fig. 1 shows a schematic of the experimental device. A pulsed-arc plasma jet was sprayed onto sample surface in a simple quartz cover. The sample is JIS SUS304 (20 × 20 × 4 mm^3).The total treatment time was 2 h, and the reduction-phase time was changed from 0 to 2 h.

Fig.2 shows the reduction-phase-time dependence of the thickness and surface hardness of the hardened layer. Both the thickness and surface hardness tended to decrease as the reduction-phase-time increased. As a result, we found that the H_2 in the nitridation-phase was enough to reduce passive film. Decrease of thickness is likely due to decrease in NH density .

REFERENCES:

[1] A. Maeda *et al.*, Proc. XXXIII Intl. Conf. Phenomena in Ionized Gases, 169 (2017).

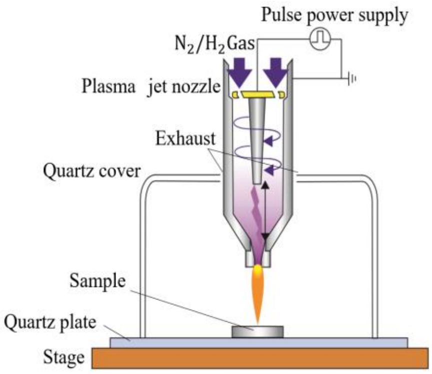

Fig.1 Schematic of experimental device.

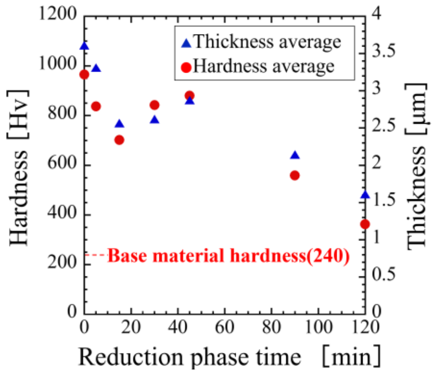

Fig.2 Dependence of hardness and thickness of hardened layer on reduction phase time.