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**Water Plasma Treatment for Low Carbon Alloy Steel Using DC Pulse Power**

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To improve wear resistance or fatigue resistance of steel, surface hardening processes such as carburizing and nitriding have been used. For example, ion nitriding is a representative process of the nitriding processes currently being used. The treatment time of ion nitriding is much shorter than that of gas nitriding. In addition, harmful gases such as ammonia are not used; therefore it is not harmful to environment. However, this process needs a vacuum furnace, and spent on the pre- and post-processes for creating, vacuum and cooling the furnace. The use of plasma has many kinds of advantages in the surface modification. Plasma can be generated in a liquid by high frequency or microwave irradiation from an underwater electrode. In this study, a nitriding process is proposed which has a much shorter treatment time with very simple equipment by using plasma electrolytic treatment. To produce plasma in the electrolyte, a JIS-SCM420 specimen was used as the cathode and a rolled punched stainless steel plate was used as the anode. Voltage was applied between the electrodes using a pulsed DC power supply. The pulsed power supply was used to prevent the discharge from concentrating on only one point. Urea, which was added into distilled water as an electrolyte, was used as the supply source of nitrogen or carbon. In addition, potassium hydroxide was added for adjusting the electrical conductivity. The voltage was 600V, and experiments were conducted by varying the conditions, such as treatment time and concentration of electrolyte. After the plasma electrolytic treatment, many fine discharge pores could be seen on the treated steel surface. In addition, a modified layer which has 1.9~2.7 $\mu\text{m}$  deep was formed on the steel surface within 5min of the start of the plasma electrolytic treatment. From the results of the XRD analysis, iron nitrides and chromium iron carbides were detected with  $\alpha\text{-Fe}$  peaks, and the hardness of the modified-layer was found to be about 800HV.

**Keywords**

water plasma  
nitriding