ABSTRACTS

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Structure and Corrosion-Resistance of AISI304 Stainless Steel Treated by Hybrid Low-Voltage / Elevated-Temperature and High- Voltage / Low-Temperature Nitrogen Plasma Immersion Ion Implantation

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Elevated-temperature, high-voltage plasma immersion ion implantation (PIII) has been shown to be an effective surface modification technique for stainless steels such as AISI304. By introducing a high pulsing rate (that is, high duty cycle), low-voltage PIII can also yield a high ion current density and elevated temperature to facilitate the rapid diffusion of implanted nitrogen and consequently to attain a relatively thick modified layer. However, one of the drawbacks of this process is the relatively low surface nitrogen concentration. Generally, the surface nitrogen atom concentration is less than 20at% thereby imposing a limit on the efficacy of the technique in terms of the enhancement of surface properties such as wear and corrosion resistance. In our recent experiments, AISI304 stainless steel samples treated by low-voltage / elevated-temperature PIII processes followed by high-voltage / low-temperature nitrogen plasma immersion ion implantation show enhanced surface and tribological characteristics. In this paper, we discuss the structures and the electrochemical corrosion properties of the treated samples. Low voltage PIII is conducted at 4kV sample voltage and the sample temperature is below 350°C. The incident ion dose for the low-voltage PIII part is $6\times10^{17}/\text{cm}^2$. Subsequently, three of the implanted samples are implanted again at a high voltage (25kV) with doses of $3\times10^{17}/\text{cm}^2$, $7\times10^{17}/\text{cm}^2$, $1\times10^{18}/\text{cm}^2$. Glancing-angle x-ray diffraction patterns reveal that high-voltage / low-temperature PIII facilitates the formation of expanded austenite phases compared to the samples treated only by low-voltage / elevated-temperature PIII processes. The expanded austenite diffraction peaks shift to a lower angle with increasing incident ion dose in the high-voltage process. Our dynamic SIMS results show that the second high-voltage nitrogen implantation process enriches oxygen in the top surface compared to the low-voltage process along. We will also present data on the pitting resistance as evaluated by electrochemical corrosion test in a 3 wt% NaCl solution and SEM (secondary electron microscopy) photographs of the corroded pits. The effects of the incident dose of the high-voltage implantation process on the corrosion properties will be discussed.