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Nitriding layer formation during high-temperature short-time plasma nitriding

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Austenitic stainless steels (ASS) are widely used in many industrial fields owing to their superior corrosion resistance. However, they possess poor wear resistance. Such drawback can be overcome with the use of surface modification treatments. The plasma nitriding process offers the advantage that a pretreatment is not necessary since the passive film is removed by sputtering. Low temperature nitriding can improve the wear resistance of ASS without loss of corrosion resistance by producing a layer composed of a supersaturated nitrogen solid solution phase (S phase). However, since the S phase excellent in hardness and corrosion resistance is formed by low temperature treatment, it takes a long time to obtain a thick hardened layer. An S phase could be formed even at high temperature during a short time treatment, although a comparison between this S phase and that formed at low temperature during a long time was not reported. Therefore, in this study, the composition and corrosion resistance of the S phases formed by high-temperature short-time treatment and conventional low-temperature long-time plasma nitriding treatment of AISI 316L were compared. The high-temperature short-time treatment was carried out from 793−913 K for 5−120 min, while the low-temperature long-time treatment was performed at 713 K for 15 h. Other processing conditions were similar, including a pressure of 200 Pa under a 25% N_2 + 75% H_2 atmosphere. A metallic screen was installed as an auxiliary cathode. After nitriding, the XRD results led to the identification of the S phase for the low-temperature long-time treatment, and revealed that the intensity of the CrN diffraction increased as the nitriding temperature and time increased for the high-temperature short-time treatment. Pitting corrosion tests revealed that the samples subjected to the low-temperature long-time and high-temperature short-time treatments possessed better corrosion resistance than the untreated sample.

Keywords
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expanded austenite
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