0.04% Gd-이상 스테인레스 강의 부식 및 마모성에 대한 집합조직 효과

Effect of Texture on the Corrosion and Wear Behaviors of 0.04% Gd-Duplex Stainless Steels

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Abstract: 0.04% Gd-duplex stainless steels (Gd-DSTSs) for neutron absorbing materials were inert arc-melted and poured into a Y-shape block with the size of 100x100x20 [mm]. The Gd-DSTS was hot rolled at 1200℃ followed by cold rolling to have 33% reduction. The average grain sizes of the rolling (RD), transverse (TD) and short transverse (ST) directions were 6, 7, 11 μm, respectively. The micro-hardnesses of the RD, TD and ST directions were 258.5, 292.3, 314.7 H_V, respectively. Corrosion potential and corrosion rate of the cold rolled Gd-duplex stainless steel in aerated artificial sea water and 0.1M H_2SO_4 solution were 0.2216 V_{SHE}, 0.0106 A/cm^2, -0.0825 V_{SHE}, 0.0168 A/cm^2 for RD, 0.2210 V_{SHE}, 0.0077 A/cm^2, 0.0817 V_{SHE}, 0.0092 A/cm^2 for TD, 0.1056 V_{SHE}, 0.0059 A/cm^2, 0.0475 V_{SHE}, 0.0069 A/cm^2 for ST, respectively. The corrosion behavior depended on the texture, which were due to mainly grain boundary and minorly crystallographic texture. Friction coefficient and wear resistance were 2.07 and 0.48 mm, respectively.

1. Introduction

As spent fuels of a nuclear power plant have been accumulated in a nuclear reactor pool, neutron absorbing materials with high performance should be developed. There are lots of materials like boron-stainless steels and borated aluminium alloys. Among these materials, stainless steels with gadolinium (Gd) is one of challengeable materials [1]. Although the Gd-duplex stainless steel is one of promise neutron absorbing materials, little information about its corrosion and wear behaviors has been still avaliable [2]. Hence, the objectives of this study are to characterize the Gd-duplex stainless steels, especially, their corrosion and wear behaviors.

2. Experimental Methods

0.04% Gd-duplex stainless steels were inert arc-melted and cast into a 100x100x20 [mm] mold. The Gd-DSTS was hot rolled at 1200℃ followed by cold rolling to have 33% reduction. Microstructure of the specimen was observed by optical microscopy (AT Microscope, MX-3000, Korea). Crystallographic texture was determined by electron backscattered diffactrometry (Jeol, JSM-7100F, Japan). Micro-hardness was measured with micro-Vickers hardness tester (HUATEC, DHV-100, China). The corrosion behavior in artificial sea water and 0.1M H_2SO_4 solution and the wear resistance were determined by potentio-dynamic method (Gamry, Gamry-100, USA) and pin-on-disk type wear tester (R&B, Triboss PD-102, Korea), respectively.

3. Results

The microstructure of the 0.04% Gd-DSTS in which the average grain sizes of the RD, TD and ST directions were 6, 7, 11 μm, respectively. The micro-hardnesses of the RD, TD and ST directions were 258.5, 292.3, 314.7 HV1, respectively. The crystallographic texture of RD, TD and ST directions showed that mainly (100) pole was concentrated to ND and (110) pole was concentrated in the center of ND and RD. Ferritic and austenitic grains were oriented parallel to RD. Corrosion potential and corrosion rate of the cold rolled Gd-DSTS in artificial sea water and 0.1M H_2SO_4 solution were 0.2216 V_{SHE}, 0.0106 A/cm^2, -0.0825 V_{SHE}, 0.0168 A/cm^2 for RD, 0.2210 V_{SHE}, 0.0077 A/cm^2, 0.0817 V_{SHE}, 0.0092 A/cm^2 for TD, 0.1056 V_{SHE}, 0.0059 A/cm^2, 0.0475 V_{SHE}, 0.0069 A/cm^2 for ST, respectively. The corrosion behavior depended on the texture, which were due to mainly grain boundary and minorly crystallographic texture. Friction coefficient and wear resistance were 2.07 and 0.48 mm, respectively.

References

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