An-isotropic Corrosion Behavior of A Marine Steel with Cold Rolling

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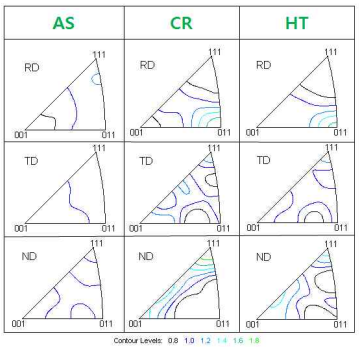
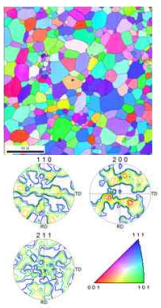
Abstract : Microstructure of a marine steel with a modified AISI-1004 composition was controlled by cold rolling and heat treatment, which corrosion behavior in an artificial sea water was electrochemically determined for the each deformation direction. The lowest corrosion rate of the surface normal to the rolling direction is related t the (111)<uv0> fiber structure. Additional annealing at 550℃ for 24 hours improves the corrosion rate which is related to re-crystallization and reduction of (111) concentration

1. Introduction

Since a marine steel is under severe corrosive conditions, it is necessary to improve its corrosion resistance by controlling microstructure. In case of BCC single crystal, pitting corrosion initiation is in the order of (110)>(100)>(111) due to their surface energy, which means that there is an-isotropic corrosion behavior of the BCC materials [1-3]. In this study, microstructure of a marine steel was controlled by a cold rolling and additional heat treatment to determine the an-isotropic corrosion behavior in an artificial sea water.

2. Experimental Results





A modified AISI-1004 steel was cold-rolled for 80% reduction of thickness without a lubricant. Crystallographic texture was determined by X-ray and EBCD, respectively. Cold rolling tends to concentrate (011) to RD, (111) to TD and (111) to ND, respectively. Annealing at 550℃ for 24 hours changes the pole distribution such as reduction of (111) to TD and (111) to ND. An-isotropic corrosion behavior was observed which is related to crystallographic texture.

3. Conclusions

(1) As-received specimen with relatively equiaxed grains had a texture with aspect ratio of about 160 on the normal surface to the rolling direction.
(2) The anisotropic corrosion behavior of the cold rolled specimen was observed. The lowest corrosion rate of the surface normal to the rolling direction is related to the (111)<uw0> fiber structure.
(3) Additional annealing at 550℃ for 24 hours improves the corrosion rate which is related to re-crystallization and reduction of (111) pole concentration.

References

1. J. Kroger, J. Electrchem. Soc., vol. 106, p. 736 (1959)
2. M. Yasuda, F. Weinberg, D. Tromans, J. Electrochem. Soc., vol. 137, p. 708 (1990)
3. H.R. Wenk, P.V. Houtte, Rep. Prog. Phys., vol. 67 p. 1367(2004)