Effect of Ni_3Ti on strength improvement in corrosion resistant $Ni_{40}Fe_{32}Cr_{20}Ti_4Mo_4$ High-entropy alloy

Weimin Qin[1, 2], Zhiming Gao [1, 2]

[1] *School of Material Science and Technology, Tianjin University, Tianjin 30072, China*

[2] *Tianjin Key Laboratory of Composite and Functional Materials, Tianjin 300350, China*

Presenter's e-mail address: qin_3956@tju.edu.cn

Abstract Due to the exhibited promising comprehensive properties [1], High-entropy alloys (HEAs) has received increasing attention ever since it was first reported. Among various HEAs, precipitation-hardened HEAs (PH-HEAs) has exhibited outstanding mechanical properties. The extensively studied HEAs hardened by secondary phases such as $L1_2$ and B2 phase have high-strength and large-ductility at room temperature. However, secondary phase in most reported HEAs with good strength and ductility usually contains harmful elements to corrosion resistance, such as Al [2], and the application was restricted. Ni_3Ti phase eliminates the negative effect of Al on passive film and has good strength and plasticity . Different from the widely studied corrosion behavior of B2 [3] and $L1_2$ phase [4], Ni_3Ti phase received little concern. To design corrosion resistant Ni_3Ti-hardened HEAs, it is necessary to study its corrosion behaviour.

In this work, Ni_3Ti-hardened $Ni_{40}Fe_{32}Cr_{20}Ti_4Mo_4$ HEA (Ti4Mo4) was designed, and was produced via inductive arc melting furnace. Spherical Ni_3Ti phase (SNPs, enriched in Ni, Ti with minor Fe and Cr) precipitated at grain interior, lamella Ni_3Ti phase (LNPs, enriched in Ni and Ti) precipitated at partial grain boundary. Effect of Ni_3Ti phase in Ti4Mo4 on corrosion resistance and passive film properties in 15 wt.% NaCl, as well as mechanical properties and crack initiation during tensile was investigated. Transpassivation potential of Ti4Mo4 reached 1.05 mV_{SCE}, ultimate tensile stress was 1189 MPa, elongation was 27%. The continuous and protective passive film on whole surface resulted in the good corrosion resistance, and no pits formed. The plastic deformation ability of Ni_3Ti phase contributed to the good mechanical properties.

Keywords High-entropy alloys; Ni_3Ti phase; Corrosion behavior; Passive film; In-situ EBSD

Reference

[1] T. Yang, Y.L. Zhao, Y. Tong, et al., Science 362 (2018) 933-937.
[2] P. Shi, R. Li, Y. Li, Y., Science 373 (2021) 912-918.
[3] Y. Shi, L. Collins, R. Feng, et al.,Corros. Sci. 133 (2018) 120-131.
[4] J.Y. Zhang, T.H. Chou, J.X. Zhang, et al., Corros. Sci. 235 (2024).