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Author Hsin Yuan Tsao
Author's Email Address No Public.
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Abstract
The purpose of the present study is an attempt to examine the effects of aging treatment and cryogenic treatment on the microstructural changes and Mechanical properties of an Fe-28Mn-8Al-1.5C alloy by means of optical microscopy(OM), transmission electron microscopy(TEM), hardness tester and wear resistance tester.
Based on our experimental examinations, some results were given below. (1) In the as-quenched condition, the microstructure of the Fe-28Mn-8Al-1.5C alloy was fully austenitic phase. (Fe,Mn)3AlCX carbides with L'12 crystal structure precipitated within the austenite matrix. When the alloy was solution treated and then cryogenic treated for 72 hours, a large number of slip-line defects and twins could be observed. Based on our TEM observations, it was found that the cryogenic treatment also promoted the formation of (Fe,Mn)3AlCX carbides within the austenite matrix. (2) When the alloy was cryogenic treated and then aged at 450℃, the surface hardness and wear assistance properties improved slightly. When the alloy was cryogenic treated and then aged at 550℃, the alloy possessed the maximum surface hardness, however the wear assistance property was inferior to that of the alloy aged at 450℃. The above experimental results indicated that the toughness property was also the important factor to affect the wear assistance property of the Fe-Mn-Al-C alloy. (3) The hardness values of the alloy aged at 350℃ for 72 hours were smaller than those of the as-quenched alloy, indicating that the effect of the precipitation strengthening was not significant at the aging temperature of 350℃, which has never been reported by other researchers before. When aged at 450℃ and cryogenic treatment, the hardness of alloy was increase effectively, but the wear resistance still keeps unchanged after cryogenic treatment. (4) When the alloy was aged at 550℃ for prolonged times, (Fe,Mn)3AlCX carbides not only precipitated within the austenite matrix but also formed on the γ/γ grain boundary, resulting the phase decomposition sequence of γ→(γU+B4＋κU+B4) on the region adjacent to the γ/γ grain boundary. The cryogenic treatment contributed (Fe,Mn)3AlCX carbides to be smaller and tinier both within the austenite matrix and on

the grain boundary. The cryogenic treatment indeed promoted the surface hardness and wear assistance properties. (5) The appropriate particle size of the (Fe,Mn)3AlCX carbides within the austenite matrix was beneficial for the Fe-28Mn-8Al-1.5C alloy to possess the excellent combination of surface hardness and wear assistance properties through the cryogenic treatment. (6) When the alloy was aged at 650℃ for prolonged times, a large number of (Fe,Mn)3AlCX carbides formed on grain boundaries. With prolonged aging, the (Fe,Mn)3AlCX carbides grew rapidly towards the adjacent austenite matrix. The cryogenic treatment induced the coarsening phenomenon of (Fe,Mn)3AlCX carbides and the phase decomposition of $\gamma \rightarrow (\kappa U + B4 + \alpha)$. Therefore, the cryogenic treatment was not advantageous for the alloy aged at 650℃. (7) Summarily, the cryogenic treatment could really promote the surface hardness and wear assistance properties of the Fe-28Mn-8Al-1.5C alloy, however, the aging temperature should be controlled to the range below 550℃. In the present research, the Fe-28Mn-8Al-1.5C alloy could possess the best combination of surface hardness and wear assistance properties after being aged at 550℃ for 24 hours and then cryogenic treated for 72 hours.
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