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Abstract
The purpose of the present study is an attempt to examine the effects of Co additions on the microstructural developments and phase transformations of the Fe-28Mn-8Al-1C alloy by means of optical microscopy, transmission electron microscopy and energy-dispersive X-ray spectrometry.

Based on our TEM examinations, it was concluded as belows : (1) When the Fe-Mn-Al-C alloy without Co content was aged at temperatures ranging from 550℃ to 650℃, (Fe,Mn)3AlCX carbides precipitated coherently within the austenite matrix. The hardness was about HRC35. (2) The hardness of the Fe-Mn-Al-C alloy with small amount of Co addition (less than 5%) decreased significantly. TEM examinations revealed that no (Fe,Mn)3AlCX carbides could be observed within the austenite matrix, resulting in the obvious decrease of the hardness and strength. This result indicated that the small amount of Co addition inhibited the precipitation of (Fe,Mn)3AlCX carbides within the austenite matrix of the Fe-Mn-Al-C alloy, which has never been reported by other workers in the Fe-Mn-Al-C alloy system before. (3) In the as-quench condition, the microstructure of the Fe-28Mn-8Al-10Co-1C alloy was a mixture of the austenite matrix and fine (Fe,Mn)3AlCX carbides precipitated on high density of quenched-in dislocations. The particle size of (Fe,Mn)3AlCX carbides was about 20nm in diameter. When the alloy was aged at temperatures ranging from 450℃ to 550℃, (Fe,Mn)3AlCX carbides grew on high density of as-existing dislocations. The particle size of these (Fe,Mn)3AlCX carbides were significantly smaller than those observed in the Fe-28Mn-8Al-1C alloy without Co content. The average particle size of (Fe,Mn)3AlCX carbides was about 35nm. The hardness increased significantly to be about HRC45, which is attributed to the strengthening effects of both precipitation of nano-scale (Fe,Mn)3AlCX carbides and the existence of high density of dislocations within the austenite matrix. (4) When the Fe-28Mn-8Al-10Co-1C alloy was aged at 650℃ for 24 hours, (Fe,Mn)3AlCX carbides grew rapidly within the austenite matrix. The as-existing dislocations within the austenite matrix disappeared at this aging temperature. The particle size of there (Fe,Mn)3AlCX carbides ranged from 30 to 150nm in diameter. When the aging time period was prolonged to 48 hours or above, a new-type precipitate could be observed within the austenite matrix besides fine (Fe,Mn)3AlCX carbides. Based on our EDS examinations, the chemical composition of the new-type precipitate is abundant in cobalt content and deficient in aluminum content. The hardness increased more significantly to be about HRC48, which is attributed to the strengthening effects of the formation of both (Fe,Mn)3AlCX carbides and new-type precipitates within the austenite matrix. This result has also never been found by other researchers before.

Advisory Committee Chung-Chun Wu - advisor

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