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Abstract
The purpose of the present study is an attempt to examine the effects of aging treatments on the microstructural changes and ordering phase transformations of an Fe-15Mn-8Al-10Co-1C alloy by means of optical microscopy (OM) and transmission electron microscopy (TEM). The effects of decrease in manganese additions on the microstructural changes of the Fe-Mn-Al-Co-C alloy are also investigated.
Based on our TEM examinations, it was concluded as bellows: (1) In the as-quenched condition, the microstructure of the Fe-15Mn-8Al-10Co-1C alloy was the mixture of (ferrite + austenite) phases. TEM examinations revealed that no carbides precipitated within the austenite matrix, however, (B2+D03) phases could be found within the ferrite region. The domain sizes of B2 and D03 ordered phases were very tiny, showing that the B2 and D03 ordered phases were formed by the continuous ordering transformation. (2) When the Fe-15Mn-8Al-10Co-1C alloy was aged at temperatures ranging from 450℃ to 850℃, the ordering transformation sequence of （α+D03）→（α＋B2）→（α+ B2*）→（α＋B2）→ B2 → α occurred within the ferrite region. Besides, extremely fine (Fe,Mn)3AlCX carbides (κ carbides) with nano-scale sizes could be observed within the austenite matrix after being aged from 475℃ to 650℃. (3) When the alloy was aged at 550℃, B2* particles which formed by nucleation and growth mechanism could be observed within the （α＋B2） region. Along with the growth of B2* particles, the phase transformation sequence of （α＋B2）→（α+ B2+ B2*）→（α＋B2*） could be found. (4)When the alloy was aged at 550℃, the ferrite particles could be observed on the γ/γ grain boundary and D03 particles precipitated within the ferrite particles by nucleation and growth mechanism. With increasing the aging temperature to 650 ℃, the B2 particles in place of D03 particles could be found with the ferrite particles on the γ/γ grain boundary. This result has never been found by other researchers before. (5) The experimental results indicated that the decrease in manganese content of the Fe-28Mn-8Al-10Co-1C alloy inhibited the precipitation of κ carbides within the austenite matrix and also enhanced the formation of (B2+D03) ordered phases within the ferrite region.
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