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In Situ Synthesis and Strengthening of Ultra High-Carbon Martensitic Stainless Steels in Addition of LaB₆

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Abstract

A powder metallurgy route which is characterized by the vacuum solid state sintering is utilized to fabricate Fe-20Cr-3C and Fe-20Cr-3C-2Mo-3V-2Co ultra high-carbon martensitic stainless steels. A sintering window between 1190-1210°C is chosen to obtain high density samples and avoid liquid phase simultaneously. The densification process is promoted by solubility effect during formation of M₇C₃ and grain boundary diffusion. TEM analysis demonstrates three types of reaction products: the La(BO₂)₃ phase, the La₂O₃ phase and the La(Fe_{0.5}V_{0.5})O₃ phase, after adding 0.1 wt.% LaB₆. The impurity elements such as S and O are absorbed following the LaB₆ addition to form non-gaseous products, which promotes densification by decreasing the sintering resistance and thus contributes to the improvement of bending strength and hardness. Both of the electrochemical and immersion results lead to the fact that the corrosion resistance of the steels are improved by 0.1 wt.% LaB₆ addition, in 3.5 wt.% NaCl solution. However, the corrosion resistance of Fe-20Cr-3C-0.1LaB₆ still can not compete with that of 316L stainless steel. Nevertheless, Fe-20Cr-3C-2Mo-3V-2Co and Fe-20Cr-3C-2Mo-3V-2Co-0.1LaB₆

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