Enhancing stress corrosion cracking resistance of high-strength bolt steels by Cu and Nb microalloying

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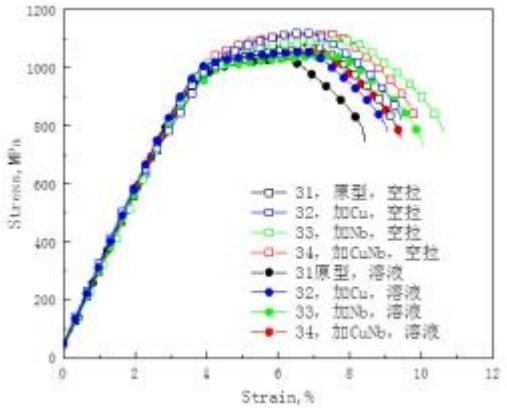
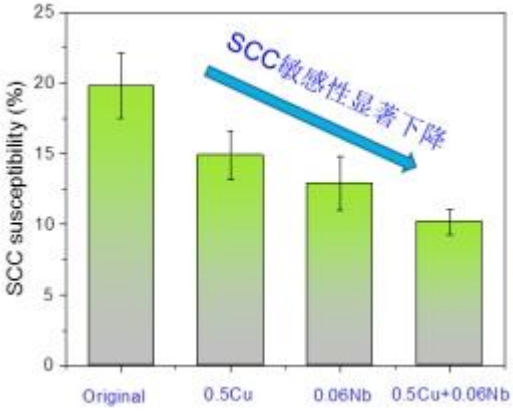
Abstract: High-strength bolt steels, as the key load-bearing components of major engineering equipments, are closely related to the service security of the equipments. However, the leading kind of high-strength bolt steels in our country are frequently suffered from stress corrosion cracking (SCC) mainly due to the lack of corrosion-resistance design. Therefore, this work aims to improve the SCC resistance of high-strength bolt steels through microalloying based on the leading kind of 12.9 grade bolt steel 20MnTiB and attempt to clarify the underlying mechanism.

In our work, the SCC behaviors of 20MnTiB bolt steels microalloyed with Cu and Nb were investigated in simulated acid rain. It reveals the addition of 0.5%Cu or 0.06%Nb was able to largely reduce the SCC susceptibility separately. Moreover, the joint addition could further reduce its susceptibility. The addition of Cu can improve the corrosion resistance of bolt steel and inhibit localized corrosion. There were few secondary microcracks on lateral surface, implying the SCC initiation has been inhibited. The addition of Nb could inhibit hydrogen evolution reaction and decrease the penetration of hydrogen atoms into matrix. Besides, NbC could react as strong hydrogen traps and reduce hydrogen embrittlement. Moreover, the addition of Nb could significantly increase the LAGB density and reduce the HAGB density, which is beneficial for prohibiting crack initiation and propagation.

Keywords High-strenght bolt steel; microalloying; acid rain; stress corrosion cracking





Reference

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