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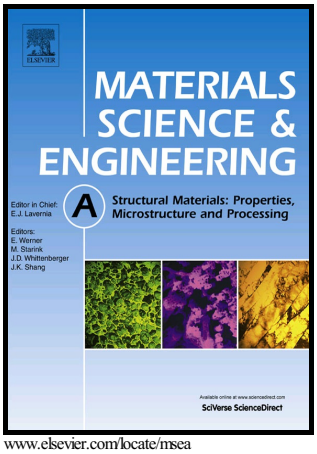

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Effects of co-addition of Ni and Al on precipitation evolution and mechanical properties of Fe-Cu alloy

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ABSTRACT Fe-Cu and Fe-Cu-Ni-Al alloys were aged at 500 °C for different time after solution treatment at 900 °C for 2 h. The influence of co-addition of Ni and Al on the microstructure evolution of Cu-rich phase was studied using atom probe tomography (APT). APT results showed that the addition of Ni and Al effectively increased the number density of Cu-rich particles and reduced their sizes with a narrow size distribution. In the peak hardness condition, the precipitates in the Fe-Cu-Ni-Al alloy exhibited a core-shell structure with the Cu-rich phase in the core and NiAl phase in the outer shell, leading to a dramatic improvement of peak hardness and strength. The NiAl shell of the precipitates impeded the growth and coarsening of the Cu-rich phase by decreasing the interfacial energy and the diffusion rate of Cu, Ni and Al atoms in the shell. After further ageing, the core-shell structure of the precipitates decomposed, forming separate Cu-rich phase and NiAl phase.

KEY WORDS Cu-rich phase, Precipitation hardening, Atom probe tomography Fe-Cu-Ni-Al alloy, Ageing

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1. Introduction

Cu precipitation strengthening in steels has been studied extensively and has