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Enhancement of <001> recrystallization texture in non-equiatomic Fe-Ni-Co-Al-based high entropy alloys by combination of annealing and Cr addition

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ABSTRACT

Formation of strong <001> recrystallization texture in new non-equiatomic Fe-Ni-Co-Al-based high entropy alloys has been investigated. Optimal annealing temperature and time to obtain strong <001> texture is subsequently determined through microstructure and recrystallization texture study of cold-rolled NCACB (34.95Fe-27.5Ni-17.5Co-11.5Al-8.5Cr-0.05B at.%) at 1200^{o}C and 1300^{o}C for different annealing times. It has also been found that the recrystallization texture is influenced by grain growth and the relative grain size (d/t, d-grain size, t-sheet thickness). Furthermore, contribution of chemical composition to <001> texture has been examined in two additional cold-rolled non-equiatomic high entropy alloys, NCAB (Fe-27.5Ni-17.5Co-11.5Al-0.05B at.%) and NCATB (Fe-27.5Ni-17.5Co-11.5Al-2.5Ta-0.05B at.%), under the same optimal annealing condition used for NCACB. Comparison of texture intensity of NCAB, NCATB, and NCACB demonstrates that Cr is very effective in the formation of strong <001> recrystallization texture of Fe-Ni-Co-Al-based alloys. Based on low-angle boundary statistics, it is hypothesized that decrease in stacking fault energy is responsible for the enhanced recrystallization texture in NCACB. Additionally, it is demonstrated employing a Zener-type model for the pinning of grain boundaries by second-phase particles, that precipitated NiAl particles facilitate the abnormal grain growth in NCACB. The tensile tests results show that strong recrystallization texture and bamboo-like structure improve the ductility of NCACB.

Keywords

Non-equiatomic, High entropy alloy, Texture, Abnormal grain growth, Low angle boundaries