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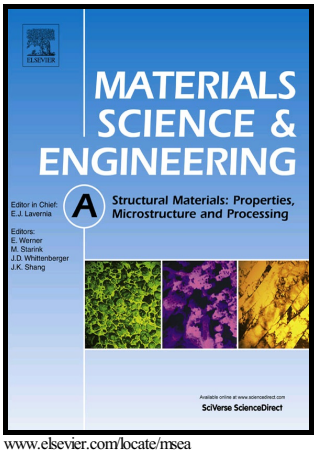

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Microstructural evolution and mechanical properties of 27Cr-4Mo-2Ni ferritic stainless steel during isothermal aging

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Abstract

The microstructural evolution and its effect on mechanical properties of 27Cr-4Mo-2Ni super ferritic stainless steels during intermediate temperature aging treatment were investigated. Experimental results demonstrated that Laves phase started to nucleate at dislocations and sub-grain boundaries before chi and sigma phase, while the chi phase and sigma phase precipitated at grain boundaries. Laves phase was partially dissolved into the matrix to provide additional Cr and Mo atoms for the rapid coarsening of sigma phase with increasing aging time during 800 ºC aging treatment. Meanwhile, the average grain size increased from ~68 to ~111 μm. Mechanical properties such as RT impact toughness, tensile properties and micro hardness were significantly influenced by the brittle intermetallic and grain coarsening. When the alloy was aged at 800 ºC, the rate of microhardness increase was accelerated by the formation and coarsening of sigma phase, and the value of Vickers hardness was positively correlated with the volume fraction of sigma phase. Impact toughness was much more sensitive to brittle precipitates than both the tensile properties and hardness. Precipitation of sigma phase induced brittle fracture during impact testing, especially in the situation where the grain boundaries were completely covered by sigma phase.

Keywords: Super ferritic stainless steel; Aging treatment; Precipitation; Hot rolling; Embrittlement

1. Introduction

Super ferritic stainless steels (SFSSs) characterized by attractive mechanical properties,