Accepted Manuscript

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PII: S0925-8388(18)31191-5

DOI: 10.1016/j.jallcom.2018.03.314

Reference: JALCOM 45544

To appear in: *Journal of Alloys and Compounds*

Received Date: 24 September 2017

Revised Date: 22 March 2018

Accepted Date: 25 March 2018

Please cite this article as: D. Wu, D. Li, S. Lu, Effect of Cr content on the microstructural stability and impact-toughness evolution of a Ni-Fe-based weld metal, *Journal of Alloys and Compounds* (2018), doi: 10.1016/j.jallcom.2018.03.314.

Effect of Cr content on the microstructural stability and impact-toughness evolution of a Ni-Fe-based weld metal

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Abstract

Microstructural stability and impact-toughness evolution of a Ni-Fe-based weld metal with different Cr contents was investigated during long-term thermal exposures up to 10000 h at 700 □. With an increase in the Cr content from 21.1 to 23.5 at.%, plate-like sigma (σ) and α-Cr phases formed during the thermal exposure. These phases were mainly located in the interdendritic areas and grew significantly as the thermal exposure time increased. The coarsening process of the γ′ phase obeyed the Lifshitz, Slyozov, and Wagner (LSW) model, and the γ′ particles maintained a coherent relationship with the γ matrix during the thermal exposure. Carbides ($M_{23}C_6$) formed and coarsened at the grain boundaries, and their distribution gradually transformed from discontinuous to continuous during the thermal exposure. The evolutions of the γ′ phase and $M_{23}C_6$ carbides were not significantly affected by the Cr-content variation. As the thermal exposure time increased, the room-temperature impact toughness degraded significantly, and a ductile (intragranular)/brittle (mixed intergranular and intragranular) transition occurred. The degradation of impact toughness mainly occurred due to coarsening of the $M_{23}C_6$ carbides along the grain boundaries and the growth of plate-like phases (σ, α-Cr) in the interdendritic areas.

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