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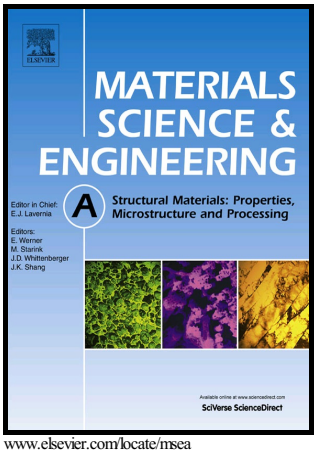

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ACCEPTED MANUSCRIPT

Microstructure and stress-rupture life of high W-content cast Ni-based superalloy after 1000℃ to 1100℃ thermal exposures

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Abstract

High W-content cast Ni-based superalloy which can be served as isothermal forging die materials over 1050 °C was investigated in this paper. Based on the microstructure evolutions, stress-rupture life of the alloy were examined under 1100 °C /70MPa, where the alloy was evaluated after thermally exposed at 1000, 1050, and 1100 °C for 100–1000h, respectively. Results showed that increasing of exposure temperature can cause coarsening and coalescing of γ′ precipitates along with a decreasing in their volume fraction, especially at 1100 °C. The coarsening rate of the γ′ precipitates increased with the exposure temperature and followed by the modified Lifshitz-Slyozov-Wagner coarsening theory of Ostwald ripening. The coarsening rate coefficient (k) at 1000, 1050, and 1100 °C was calculated to be 5.72, 7.40, and 8.71 $nm/s^{1/3}$, respectively. In addition, at those temperatures, it found the blocky M_6C carbides in the interdendritic area to be precipitated and coarsened. Furthermore, the M_6C carbides linked with each other like a chain wrapped around the grain boundary and along the eutectic γ′ phase. Because of the degradation of the microstructure, the stress-rupture life decreased after thermal exposure, from 94.8h at 1000°C to 49.3 h at 1100°C for 1000h. Finally, in view of the experimental results, a relationship between the microstructural evolution and the stress-rupture life of the alloy was discussed in details.

Keywords: Superalloy, Thermal exposure, Microstructural evolution, Stress-rupture properties

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