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Investigation of deformation mechanism for bi-modally distributed γ' precipitates in Allvac 718Plus superalloy

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Alloy Allvac 718Plus was developed to improve the properties of the widely-used superalloy Inconel 718. It has achieved an improvement in service temperature up to 704ºC (55ºC more than IN718) because of its chemical composition, microstructure and major strengthening phase, γ' [1], [2]. The high-temperature stability of the microstructure influences the mechanical properties. The dominant deformation mechanisms change with the change in size and distribution of the γ' precipitates. When the γ' precipitates are larger in size, dislocations tend to loop around them, whereas when the γ' precipitates are smaller, the dislocations tend to shear through them [3]. Through thermal processing, we have developed a bi-modal precipitate distribution (smaller precipitate average diameter ~14 nm and larger precipitate average diameter ~55 nm). In particular, a solution treatment at 1000℃ followed by two-step aging at 720℃ for 10h and 900℃ for 2h was used. After the heat treatment, interrupted tensile deformations (~2%) were conducted. Transmission electron microscopy was used to study the particle-dislocation interaction. The same set of experiments was repeated on samples having uni-modal precipitate distribution (either larger or smaller precipitates) and the results were compared. The findings will help develop a microstructure-property relationship model involving multi-modal distribution of precipitates.

Keywords: Allvac 718plus, Superalloy, Gamma prime, Bi-modal distribution, TEM, Dislocation

References:

[1] R. L. Kennedy, W. Di Cao, T. D. Bayha, and R. Jeniski, “Developments in wrought Nb containing superalloys (718 + 100°F),” *Proc. Int. Symp. Niobium High Temp. Appl.*, 2004, pp. 11–21.

[2] X. Xie, G. Wang, J. Dong, C. Xu, W.-D. Cao, and R. Kennedy, “Structure stability study on a newly developed nickel-base superalloy - Allvac 718Plus,” *Superalloys 718, 625, 706 Var. Deriv.*, 2005, pp. 179–191.

[3] A. J. Goodfellow, “Strengthening mechanisms in polycrystalline nickel-based superalloys,” *Mater. Sci. Technol. (United Kingdom)*, vol. 34, no. 15, 2018, pp. 1793–1808.