CHARACTERIZATION OF PRECIPITATION IN ALLOY 718 BY ATOM PROBE TOMOGRAPHY AND ANALYTICAL ELECTRON MICROSCOPY

M. K. Miller*, S. S. Babu* and M. G. Burke**

**Microscopy and Microanalytical Sciences Group, Metals and Ceramics Division, Oak Ridge National Laboratory, P.O. Box 2008, Oak Ridge, TN 37831-6376, USA.*

***Present address: Bechtel Bettis Inc, West Mifflin, PA 15122-0079, USA*

Alloy 718 is the most widely used superalloy and has applications in gas turbines, rocket motors, nuclear reactors, pumps and spacecraft. This precipitation hardened alloy combines high strength, excellent creep rupture strength to 700°C and corrosion resistance with outstanding weldability. Niobium-containing Alloy 718 is strengthened by a combination of DO_{22}-ordered $Ni_3(Nb,Ti)$ γ'' and $Ni_3(Al,Ti,Nb)$ γ' phases in a face centered cubic γ matrix. Previous atom probe tomography characterizations of Alloy 718 [1] revealed that the secondary or fine precipitates consisted of two distinct types of regions enriched in either niobium or in aluminum and titanium that are characteristic of the γ'' and γ' phases, respectively. Due to the different temperature ranges of the γ'' and γ' phase stability fields, the microstructure of this alloy may be manipulated by suitable selection of the annealing temperatures. If the alloy is annealed at high temperatures, the microstructure primarily consists of γ and γ'' phases. If the alloy is annealed at lower temperatures, the intragranular microstructure consists of γ, γ'' and γ' phases. In this study, the microstructural characterization focused on intragranular phases formed in the γ-γ''-γ' region of the phase diagram.

The nominal composition of the Alloy 718 used in this study was Ni- 20.7 wt% Fe, 17.6% Cr, 5.21% Nb, 2.92% Mo, 1.05% Ti, 0.55% Al, and 0.32% Co. The material was given a multistep heat treatment of 1 h at 1093 °C, 8 h at 718 °C, a slow cool at a rate of 55 °C/h to 621 °C, 8 h at 621°C and an air cool to room temperature. The microstructural characterizations were performed with an energy-compensated optical position-sensitive atom probe (ECOPoSAP) and Philips EM400T and CM12 electron microscopes equipped with Link LZ5 EDS/AN10/85S analyzers. The morphologies of the intragranular phases and their compositions were determined after each step of the heat treatment. The phase compositions were also compared to thermodynamic predictions.

1. M. K. Miller, S. S. Babu and M. G. Burke, *Mat. Sci. Eng. A*, 270 (1999) 14.

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