Quarterly Management Report

WBS Element	Project Title	Contract Number	Contract Start	Contract End
ORNL-2D	Multi-Phase High-Temperature Alloys			

Performer Name and Address	Principal Investigator(s)
ORNL	M.P. Brady, Z.P. Lu, and C.T. Liu

BUDGET AND COST REPORT

Prior Year Funds [$K]	0
Total Current Year Commitment $K]	112
Projected Current Year Costs [$K]	112

	O	N	D	J	F	M	A	M	J	J	A	S
Planned Costs	5	15	25	35	45	60	70	80	85	95	105	112
Actual Costs	5	20	32									
Variance	0	(5)	(7)	35	45	60	70	80	85	95	105	112

MILESTONE REPORT

Milestone Designation	Milestone Description	Due Date	Revised Due Date	Completion Date
2D1	1. Establish baseline high-temperature strength and phase stability in the developmental C14 and B2 precipitated Fe-20Cr-(10-20)Ni atomic percent base	06/30/05		

TECHNICAL HIGHLIGHTS

Efforts are underway for the development of multi-phase alloys for improved high-temperature strength. Work is currently focused on advanced austenitic alloys based on Al-modified Fe-(10-20)Cr-(15-25)Ni (at.%), strengthened by combinations of: (1) solid solutes, (2) carbide precipitates (MC), and (3) Laves phase precipitates. This effort is partially linked with that of 4A, “Controlled Oxidation for Functional and Protective Surfaces”.

An initial series of alloy ingots based on Fe-20Cr-(10-20)Ni (at.%) with proprietary minor alloying additions were prepared by arc melting and fabricated by hot forging at temperatures above 1100°C in air. The fabricated alloy plates were solution treated for 1 h at 1200°C, followed by annealing for 100 h at 800°C for control of precipitation. Optical examination revealed extensive precipitation of multiphase particles in alloys where Al additions were added. Electron microscopic studies showed massive precipitation of extremely fine AB phase particles (~0.3 micron in diameter). In addition, both fine and coarse particles of AB2 Laves phase and MC carbide were observed in Fe-based solid solution matrix.

Tensile properties were measured from room temperature to 750°C using sheet specimens. The tensile ductility showed a general trend of decrease with increasing AB precipitates, with a low elongation of 3.1 % for the highest Al-containing alloy at room temperature. On the other hand, these precipitates significantly hardened the alloys at ambient and elevated temperatures. For instance, AB precipitates increased the yield strength from 409 to 772 MPa at room temperature. At 600°C, the precipitates raised the yield strength from 301 to 521 MPa. An initial optimization has identified a level of additions that resulted in a yield strength of greater than 350 MPa at 750°C, yet still exhibited > 5% elongation at room temperature. Work in the next quarter will be devoted to screening of creep rupture behavior.

ISSUES

none

Report Prepared By	Date
MP Brady	05/26/05