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 and C.T. Liu

BUDGET AND COST REPORT

Prior Year Funds [$K]	11
Total Current Year Commitment $K]	110
Projected Current Year Costs [$K]	121

	O	N	D	J	F	M	A	M	J	J	A	S
Planned Costs	5	11	23	34	45	55	70	85	95	100	110	121
Actual Costs	7	12	19	27	38	48						
Variance	(2)	(1)	5	7	7	7	70	85	95	100	110	121

MILESTONE REPORT

Milestone Designation	Milestone Description	Due Date	Revised Due Date	Completion Date
2D/4A 1	3. Assess potential for intermetallic strengthened ferritic and austenitic alloys for improved elevated-temperature strength in applications	05/30/04		

TECHNICAL HIGHLIGHTS

Efforts are underway for the development of multi-phase alloys for improved high-temperature strength. Two systems are being explored: high-Nb TiAl-based intermetallics for applications from 800-1000°C and intermetallic-strengthened ferritic and austenitic alloys for applications from 650°C and up. This effort is partially linked with that of 4A, “Controlled Oxidation for Functional and Protective Surfaces”.

A series of exploratory Fe-20Cr-15Ni at.% base steel alloys with additions of Mo, Nb, C, B, and Al were cast, forged, and heat treated in an attempt to increase high-temperature capability through combined use of solid solution, carbide, and intermetallic precipitate strengthening. Preliminary microstructural analysis indicated that a promising structure of a very fine, uniform distribution of potential strengthening carbide and intermetallic Laves phase(s) has been achieved. Further microstructural characterization and tensile evaluation of these alloys are planned in the next quarter.

For the TiAl alloys, a key factor will be whether or not sufficient oxidation resistance can be achieved to permit the 40,000 h lifetimes needed in fossil energy power generation systems. The engineering TiAl alloys (those with attractive mechanical properties) tend to form mixed Al_2O_3-TiO_2 scales rather than true protective Al_2O_3, which severely limits their upper-temperature use limit. A novel approach to inducing TiAl alloys to form protective Al_2O_3 scales is the addition of noble alloying additions to enrich at the alloy/scale interface during oxidation, and modify the subsurface depletion processes which can interfere with the establishment and maintenance of the Al_2O_3 scale. A series of alloys with additions of Ni, Mn, Ag, Pt, Pd, and Ir were cast and oxidized for 1 week at 900°C in air. The Ni additions, in particular, resulted in a nearly (but not quite) continuous Al_2O_3 scale. Based on these promising results, a series of Ni-modified TiAl alloys was cast, and are currently being evaluated for oxidation behavior.

ISSUES

none

Report Prepared By	Date
MP Brady	06/01/04