Quarterly Management Report

WBS Element	Project Title	Contract Number	Contract Start	Contract End
ORNL-4A	Controlled Oxidation for Functional and Protective Surfaces			

Performer Name and Address	Principal Investigator(s)
ORNL	M.P. Brady, P.F. Tortorelli, and E.A. Payzant

BUDGET AND COST REPORT

Prior Year Funds [$K]	0
Total Current Year Commitment $K]	200
Projected Current Year Costs [$K]	200

	O	N	D	J	F	M	A	M	J	J	A	S
Planned Costs	15	32	49									
Actual Costs	15	30	45	70	90	120	150	160	170	180	190	200
Variance	0	2	4	(70)	(90)	(120)	(150)	(160)	(170)	(180)	(190)	(200)

MILESTONE REPORT

Milestone Designation	Milestone Description	Due Date	Revised Due Date	Completion Date
4A 1	1. Complete initial studies of the oxidation behavior of the first series of developmental intermetallic strengthened steels and document the results in a	08/30/05		
4A 2	Complete a series of exploratory experiments to establish the range of functional ceramic surface structures that can be synthesized via oxidation	09/30/05		

TECHNICAL HIGHLIGHTS

This effort is partially linked with that of 2D, “Multi-Phase High temperature Alloys”.

1000 h oxidation exposures of AB2, AB, and MC strengthened Fe-(10-20)Cr-(15-25)Ni (at.%) base alloys with and without Al additions at 700°C in air + 10% water vapor and at 800°C in air and air + 10% water vapor were completed. As little as 5 at.% (2.4 wt.%) Al was sufficient to significantly improve oxidation resistance in water vapor environments. (Water vapor is present in all combustion environments and can seriously degrade the oxidation resistance of Cr2O3-forming alloys). Cross-section analysis indicated Fe-rich oxide nodule formation without additions of Al, which is the classic start of breakdown of Cr2O3 in water vapor environments. In contrast, the Al-bearing alloys all formed thin, protective Al-oxide base scales. The Al was present in the microstructure as fine AB phase type precipitates, with a depleted zone underneath the growing scale, indicative of reservoir effect type behavior. The thinness of the scale precluded detailed analysis in cross-section SEM/EPMA, Auger spectroscopy will therefore be used in the coming quarter to characterize the surface.

Work in previous quarters demonstrated the use of a CoMo intermetallic precursor to synthesize the Co6Mo6C2 phase of interest for hydrotreating catalysis via gas carburization. The potential advantage of this approach is the opportunity to synthesize new phases/phase assemblages not accessible via conventional synthesis routes based on oxide or molecular precursors, due to the different set of precursor structures/stoichiometries offered by intermetallic precursors. The initial demonstration was conducted using bulk cast material. Work this quarter was directed toward evaluation of high surface area precursor material suitable for catalysis. Castings of CoMo were manufactured and delivered to an outside vendor for conversion to powder by ball milling. In collaboration with G. Veith (ORNL condensed matter division), Co and Mo target material was secured, and will be used to sputter deposit CoMo onto high surface area alumina powder using a novel approach developed by Veith. Carburization of this material will be pursued in the next quarter.

ISSUES

None

Report Prepared By	Date
MP Brady	05/26/05