Quarterly Management Report

WBS Element	Project Title	Contract Number	Contract Start	Contract End
	Metallic Filters for Hot Gas Cleanup	W-7405-Eng-82	10/01/99	09/30/04

Performer Name and Address	Principal Investigator(s)
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BUDGET AND COST REPORT

Prior Year Funds [$K]	150
Total Current Year Commitment $K]	220
Projected Current Year Costs [$K]	220

	O	N	D	J	F	M	A	M	J	J	A	S
Planned Costs	12	25	37	50	63	75	88	114	141	168	194	220
Actual Costs	15	25	25	44	68	135	0	0	0	0	0	0
Variance	(3)	0	12	6	(5)	(60)	88	114	141	168	194	220

MILESTONE REPORT

Milestone Designation	Milestone Description	Due Date	Revised Due Date	Completion Date
FY05-1	Generate at least 2-3 kg of ultrafine iron aluminide powder for studies	03/31/05		03/31/05
FY05-2	Initiate acquisition (within funding limits) of tilt pouring furnace for HPGA	03/03/05		
FY05-3	Design low energy atomization nozzle for moderate powder sizes	06/30/05		
FY05-4	Develop and demonstrate gas supply pressure control system	09/30/05		

TECHNICAL HIGHLIGHTS

Further work continued on the enhanced production of ultra-fine powders of high temperature alloys with dia. < 10 µm, which is a major objective of our research thrust involving improved powder processing for various fossil energy applications. Such powders are used, for example, for development of porous sintered metallic support structures for inorganic (ceramic) laminated membranes for physical hydrogen separation from synthetic gas in coal-fired IGCC applications. Improved porous metallic support structures also are needed for another type of hydrogen separation membrane that relies on interstitial diffusion through metallic films, e.g., Pt, Pd. The requirements for these support structures indicate that spherical ultra-fine metallic powders of high temperature, corrosion resistant alloys would be preferred, but this type of powder is a commercial rarity.

Up-scaled high pressure gas atomization (HPGA) experiments to meet this objective were completed on an iron aluminide alloy, Fe-16Al-2Cr (wt.%), that had been produced previously in an experimental (4 kg) powder batch on our research HPGA unit. The switch to an elemental alloy component charging method and an upgrade of the melt monitoring thermocouple proved successful for promoting the controlled melting and homogenization of the alloy in the industrial prototype HPGA unit. Three successive up-scaled (12 kg) gas atomization runs were performed with He gas at a G/M mass flow ratio that ranged from 1.0 to 0.7, equal to or better than commercial efficiencies. The average yield from screening of the powder at 20 microns, the desired top size boundary, was about 30% by wt., easily 6X a typical commercial powder yield. After size classification a large portion of the powder was shipped to ORNL for processing into tubular membrane supports and further testing. The remaining ultrafine powder was devoted for small scale development of model membrane support structures, including permeability testing and mechanical and microstructural analysis, after refined sintering trials. Additional discussions with S. Paglieri of LANL concerned several possible porous material options after testing is completed on the porous substrates that we provided for his vapor deposition studies on metallic hydrogen separation membranes. Inquiries have continued about funding of the expansion of the melting capacity and powder production capacity of our prototype atomization system, but appear to have reached a dead-end at this time.

Since successful performance in the last quarter of an experiment that was intended to internally oxidize an Fe-Cr-Y alloy by a gas atomization reactive synthesis (GARS) process, collaborative sintering tests have been conducted by B. Bischoff at ORNL on the powder that was provided. He has reported an encouraging gain in sintering temperature and has request an additional quantity of powder that requires an up-scaled run, probably in the next quarter. Also, collaborative TEM characterization by B. Kad of UCSD has proceeded, most successfully on the spray deposit sample. He has reported observation of the desired Y2O3 particles and encouraged alternative types of sample preparation methods that would enable more detailed TEM observations. The powder and another portion of the spray deposition sample were also shared with the e-beam characterization team from Ames Lab and a set of observations was planned for the next quarter.

The general objective of our processing research has been the development of gas atomization nozzle systems for producing ultra-fine powders that improve the yield of ultra-fine powders with He atomization gas or to produce powders with a controlled size distribution with less costly gas (Ar, N2). For both types of improved atomization process yields, modifications of the axial melt feeding tube are being pursued to improve the uniformity and pre-filming of the melt, as it is fed into the atomization zone. New atomization testing (with high-speed cinematography) of gas nozzle designs with twice the gas flow of previous nozzles was completed, using Cu and Al as the elemental melts, and analysis of the data is in-progress. This work will be reported as part of a presentation and conference proceedings publication at the APMI/MPIF annual meeting in Montreal, Canada, in June.

ISSUES

Up-scaled production of Fe-Al-Cr powder was completed and a large sample was provided to ORNL for porous membrane research, as requested, and detailed microstructural characterization of the special Fe-Cr-Y-O powders has begun. Due to the added expense of solving up-scaling problems and adding unanticipated characterization effort, a $70K funding enhancement was requested for the project and verbally approved. Also, exploration of the available funding options for upgrading of the melting capacity of our industrial prototype high pressure gas atomization system (approximately $550K needed) have not been successful (at this time) and the impending milestone on this topic must be significantly delayed.

Report Prepared By	**Date**
I.E. Anderson	03/31/05