Quarterly Management Report

WBS Element	Project Title	Contract Number	Contract Start	Contract End
ORNL-1(B)	Corrosion Resistant Coatings	FEAA028	10/01/99	09/30/31

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

Prior Year Funds [$K]	70
Total Current Year Commitment $K]	250
Projected Current Year Costs [$K]	320

	O	N	D	J	F	M	A	M	J	J	A	S
Planned Costs	27	54	80	107	134	160	187	214	240	267	294	320
Actual Costs	25	53	77	91	110	135						
Variance	2	1	3	16	24	25	187	214	240	267	294	320

MILESTONE REPORT

Milestone Designation	Milestone Description	Due Date	Revised Due Date	Completion Date
ORNL-1(B)-1	Complete the deposition and evaluation of the second series conversion coatings designed to produce scales other than silica	03/30/03		03/30/03
ORNL-1(B)-2	Complete evaluation of materials tested fY2001 NETL CERF run.	09/30/03	09/30/04	
ORNL-1(B)-3	Evaluate dip coating processing conditions for mullite as a function of coating density, coating thickness, coating adherence, and corrosion resistance.	09/30/03	06/30/04	
ORNL-1(B)-4	Evaluate dip coating processing condition for a silicate based material other than mullite as a function of coating density, coating thickness, coating adherence,	09/30/04		
ORNL-1(B)-5	Complete the deposition and evaluation of a new solution based conversion coatings designed to produce scales other than silica.	09/30/05		

TECHNICAL HIGHLIGHTS

Review: In order to utilize the attractive properties of SiC, additional measures must be employed to protect the material from corrosive environments. In many cases, systems are being developed that combine oxide and non-oxide ceramics to take advantage of the properties of both families of materials. For example, oxide ceramic coatings are being deposited on SiC and silicon nitride ceramics to protect the bulk materials from corrosion. Unfortunately, the oxide coatings do not completely prevent oxygen diffusion and thus a silica layer is formed between the substrate and the coating. Due to a low modulus and coefficient of thermal expansion (CTE), silica is not compatible with either the coating or the substrate. It is believed that the silica layer will continue to grow with time, albeit very slowly, and eventually cause the coating to fail and spall during thermal cycling. This program has been investigating several approaches to improving the environmental stability of SiC and silicon based materials. One approach that is being taken is to coat the surface of a hexaloy SiC substrate using slurry based coatings.

Results: Development continues on the improvement of dip coat slurry stability through the evaluation of alternative dispersants and binder systems. Sedimentation, rheology, surface charge, and dipping (characterization of coating thickness and uniformity as a function of slurry and dip variables) experiments continue. This quarter utilized last quarters's research of the behavior of aqueous mullite suspensions. The concentrated suspensions (~ 45 vol%) fabricated were used to dip coat SASiC substrates. The substrates were subsequently heat treated at varying temperatures and environments to determine the optimum heat treatment conditions and resulting coating thicknesses and densities. To date, dense coatings have been achieved at temperatures as low as 1350 C in air. Average coating thicknesses are 120 microns , however, coverage at corners and edges is minimal.

Evaluation of the activities and reactivity of candidate materials in controlled environments continues. On-going activities include collaboration with Peter Tortorelli (ORNL) on the testing of the doped alumino-silicates in the microbalance/TGA. Ted Besmann and Nagraj Kulkarni will be assisting in the thermodynamic modeling of the solid-gas phase relationship in these test condiitons once more data is collected by Peter. In addition, all data that is generated on this project and other collaborative projects will be collected and sorted into a database for future reference and publication.

Work continued on the investigation of new or alternative coating materials. Calcium aluminate was identified as a potential coating material system during some investigation previously this past fiscal year. Mechanical property evaluation before and after exposure to high temperature, thermal cycling, high temperature steam, and salt environments was completed. In general, the composition is stable after exposure to the three environments. Subsurface flaws form after exposure resulting in a 10-15% reduction in strength. In the case of molten salt exposure, the calcium leached out, and the alumina grains were left behind. Based on the SEM characterization of the fracture surfaces, processing flaws are the dominant strength limiting flaws. A paper summarizing the results is in-process.

Analysis of the samples returned from the NETL/CERF run in late FY02/earlyFY03 continues. SEM analysis of the 75% of the ceramic samples has been completed to date. Papers summarizing these results are in-process.

ISSUES

None to report.

Report Prepared By	Date
B.L. Armstrong	05/17/04