Quarterly Management Report

WBS Element	Project Title	Contract Number	Contract Start	Contract End
01	Development of Seals for Membranes	12461	10/01/03	09/30/04

Performer Name and Address	Principal Investigator(s)
Pacific Northwest National Laboratory 902 Battelle Blvd P.O. Box 999 Richland WA 99352	K Scott Weil

BUDGET AND COST REPORT

Prior Year Funds [$K]	135
Total Current Year Commitment $K]	485
Projected Current Year Costs [$K]	400

	O	N	D	J	F	M	A	M	J	J	A	S
Planned Costs	45	100	130	160	190	220	250	280	310	340	370	400
Actual Costs	45	91	124									
Variance	0	9	6	160	190	220	250	280	310	340	370	400

MILESTONE REPORT

Milestone Designation	Milestone Description	Due Date	Revised Due Date	Completion Date
3-1	Initiate an investigation of the mechanisms of Ag-CuO wetting on dense and porous alumina bodies.	11/30/03		11/30/03
3-2	Complete our investigation of the mechanisms of Ag-CuO wetting on dense and porous alumina bodies.	02/28/04	03/30/04	
3-3	Assess the viability of aluminum-based alloys in air brazing.	05/31/04	06/30/04	
3-4	Demonstrate the viability of a compliant braze to be used in sealing ceramic membranes and aluminide gas manifolds for long-term, high-temperature	09/30/04	10/30/04	

TECHNICAL HIGHLIGHTS

Initiate an investigation of the mechanisms of Ag-CuO wetting on dense and porous alumina bodies
(Completion of Milestone 3-1 for FY2004)
We have initiated a project with Professor Alan Meier at Alfred University to investigate the wetting mechanisms of the Ag-CuO braze on porous alumina. The porous alumina bodies have been prepared by cold pressing and sintering of alumina powders and infiltration was conducted in a dense alumina cup using a braze composition of 10mol% CuO in Ag. A high degree of infiltration was observed (> 1mm depth) in our initial SEM analysis. We are also examining how a similar silver-vanadia air braze performs in these tests. Our objective is to understand how we can control the amount of infiltration that takes place in order to obtain effective joints with ORNL's nanoporous alumina hydrogen membranes.

Investigation into Compositional Modifications of the Ag-CuO Air Braze
(Partial Completion of new Milestone 3-4 for FY2004)
Last year we developed a new approach to ceramic brazing, referred to as air brazing, that employs an oxide wetting agent dissolved in a molten noble metal solvent, in this case CuO in Ag, such that acceptable wetting behavior occurs on a number of ceramic substrates. In an effort to explore how to increase the operating temperature of this type of braze, we have investigated the effect of ternary palladium additions on the wetting characteristics of our standard Ag-CuO air braze composition. Our findings from macroscopic contact angle experiments conducted on alumina substrates indicate that palladium does cause a measurable increase in the wetting angle, but that as little as 1mol% CuO would provide an acceptable level of wetting in the Ag-CuO and 25Pd-75Ag-CuO braze families and ~10mol%CuO in the 50Pd-50Ag-CuO brazes. However, microstructural analysis revealed that while this is true for the binary braze system, little wetting actually took place in the 99(1:3)01PAC braze. A more promising microstructure was observed in the 96(1:3)04PAC sample, which displayed a thin, non-continuous CuO-Al_2O_3 interdiffusion zone between the braze and the substrate. While increases in the CuO concentration show improved macroscopic wetting, a thick interfacial layer of CuO segregates to the alumina faying surface and tends to form microsopic cracks, suspected to initiate upon cooling. This work is being conducted in collaboration with Professor Amit Bandyopadhyay and Jens Darsell at Washington State University.

Papers Submitted for Publication During the 1st Quarter of FY2004
1. K. S. Weil, “High Temperature Electrical Testing of a Solid Oxide Fuel Cell Cathode Contact Material,” Journal of Materials Engineering and Performance.
2. K. Weil, C. Coyle, J. Hardy, J. Kim, and G. Xia, "Sealing Metallic and Ceramic Components in Planar Solid Oxide Fuel Cells," Proceedings of the 2003 Fuel Cell Seminar.
3. J. S. Hardy, J. T. Darsell, C. A. Coyle, J. C. Birnbaum, and K. S. Weil, "Thermal Cyclability of Reactive Air Braze Seals in Anode Supported Solid Oxide Fuel Cells," Joining of Advanced and Specialty Materials VI.
4. K. S. Weil, and J. P. Rice, "The Influence of Ceramic and Metallic Substrates on the Oxidation Behavior of Gold ABA," Joining of Advanced and Specialty Materials VI.
5. K. S. Weil, J. S. Hardy, and J. T. Darsell, "Investigation of a Novel Air Brazing Composition for High-Temperature, Oxidation-Resistant Ceramic Joining," Proceedings of the 28th Annual Conference on Composites, Advanced Ceramics, Materials, and Structures.

Papers Accepted for Publication During the 1st Quarter of FY2004
1. K. S. Weil, J. S. Hardy, and J. Y. Kim, “A New Technique for Joining Ceramic and Metal Components in High Temperature Electrochemical Devices,” invited paper, Journal of Advanced Materials.
2. J. S. Hardy, J. Y. Kim, and K. S. Weil, “Joining Mixed Conducting Oxides Using an Air-Fired Electrically Conductive Braze,” Journal of the Electrochemical Society.
3. J. Y. Kim, J. S. Hardy, and K. S. Weil, “Use of Aluminum in Air Brazing Aluminum Oxide,” Journal of Materials Research.

ISSUES

None of the FY04 project funding has been yet been received through the 1st Quarter of FY04 (the work during this quarter was funded from FY03 carryover). This has caused the completion dates for milestones 3-2, 3-3, and 3-4 to be delayed by one month.

Report Prepared By	Date
K Scott Weil	01/27/04