Quarterly Management Report

WBS Element	Project Title	Contract Number	Contract Start	Contract End
01	Development of Seals for Membranes	12461	10/01/03	09/30/05

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]	218
Total Current Year Commitment $K]	618
Projected Current Year Costs [$K]	504

	O	N	D	J	F	M	A	M	J	J	A	S
Planned Costs	42	84	126	168	210	252	294	336	378	420	462	504
Actual Costs	22	44	55	76	100	119						
Variance	20	40	71	92	110	133	294	336	378	420	462	504

MILESTONE REPORT

Milestone Designation	Milestone Description	Due Date	Revised Due Date	Completion Date
3-1	Complete studies on the effects of Pd alloying on the liquidus temperature and wetting mechanisms of Ag-CuO.	11/30/04		11/30/04
3-2	Initiate study of the effects of TiO2 on the liquidus temperature and wetting mechanisms of Ag-CuO.	02/28/05		01/31/05
3-3	Evaluate the corrosion resistance of a ceramic membrane/alloy gas manifold joint, brazed using one of the newly developed brazing filler metal systems, in	05/31/05		
3-4	Develop an internal source of exothermic heating to melt the air brazes locally in place.application in H2 separation.	09/30/05		

TECHNICAL HIGHLIGHTS

Initiate study of the effects of TiO_2 on the liquidus temperature and wetting mechanisms of Ag-CuO (in partial completion of Milestone 3-2)

Reliable joining methods are required for high-temperature oxide membrane-based separation devices (both oxygen and hydrogen) to be successfully developed. However, high operation temperatures and low tolerances of many of the candidate oxide compositions for reducing environments severely limit the number of joining technologies that can be considered for this application. For many of the ceramic membrane materials, joining must take place in air to avoid reduction, phase separation, and consequential degradation of the transport properties of the material. Furthermore, in evaluating candidate joining techniques, one must remember that the joint must withstand stresses imposed by thermal cycling and, in many cases, must also hermetically seal the device to maintain the appropriate chemical gradient across the electrochemically active membrane during the device's operation.

Reactive air brazing (RAB) forms a predominantly metallic joint directly in air without the need for fluxing. The process utilizes braze compositions that, in the molten state, consist of a metal oxide that is at least partially dissolved in a noble metal filler material. Ag-CuO has been found to be one such material system that is well suited for the RAB process. In our most recent studies we have examined how the addition of Ti to the Ag-Cu alloy further enhances the surface wetting of the braze on LSCF and YSZ. Like the Cu alloying component in the braze, Ti also oxidizes in-situ during firing to form its oxide. It has been found that TiO_2 additions as small as 0.5mol% significantly improve the wetting characteristics of the Ag-CuO braze and when properly controlled can increase joints strengths as much as ~20%.

Papers Submitted During the 2nd of FY2004

1. Jin Yong Kim, John S. Hardy, and K. Scott Weil, "Aluminum Air Brazing for Joining Ceramics," Joining of Advanced and Specialty Materials VIII, ASM International, 2005.
2. N.M. Zink, A.M. Meier, K.S. Weil, and J.S. Hardy, "Reactive Air Brazing of LSCoF and Alumina with Ag-V_2O_5 Alloys," Proceedings of the 29th Annual Conference on Composites, Advanced Ceramics, Materials, and Structures, the American Ceramics Society, 2005.
3. M.C. Lamb, S.J. Camardello, A.M. Meier, K.S. Weil, and J.S. Hardy, Brazing of Porous Alumina to Monolithic Alumina with Ag-CuO and Ag-V_2O_5," Proceedings of the 29th Annual Conference on Composites, Advanced Ceramics, Materials, and Structures, the American Ceramics Society, 2005.
4. Jin Yong Kim, K. S. Weil, and John S. Hardy, "Reactive Air Brazing for High-Temperature Electrochemical Applications," Joining of Advanced and Specialty Materials VIII, ASM International, 2005.
5. Jin Yong Kim, John S. Hardy, and K. Scott Weil, "Novel Metal-Ceramic Joining for Planar Solid Oxide Fuel Cells," J. Electrochem. Soc., in press.

ISSUES

Report Prepared By	Date
K Scott Weil	04/17/05