Pacific Northwest NATIONAL LABORATORY

Proudly Operated by Battelle *Since 1965*

U.S. DEPARTMENT OF ENERGY

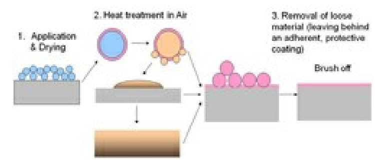
Available Technologies

Reactive Air Aluminizing

Battelle Number(s): 15848, 30139-E

Patent(s) Issued

Available for licensing in all fields



SUMMARY

Low-cost oxidation-resistant ferritic stainless steels are promising candidate materials for interconnects and frames in high-temperature electrochemical devices such as solid oxide fuel cells (SOFC) and solid oxide electrolysis cells. However, without a protective coating, chromium can evaporate from these steels during operation and poison the electrochemical cell, thereby degrading performance over time. Coating the steel with aluminum could solve this problem, but conventional approaches require coatings to be applied before components are assembled and often involve expensive precursor materials. Sometimes additional high-temperature heat treatments are also needed. These extra processing steps can increase manufacturing costs.

Researchers at the Pacific Northwest National Laboratory (PNNL) have developed a process for applying a protective aluminum coating to surfaces of metallic parts and components in already assembled devices. A key benefit to this reactive air aluminizing process is that it is performed in air, eliminating the need for more costly and involved approaches for heating requiring controlled-atmosphere environments.

The process sandwiches aluminum between metal components and a refractory material when heated in an oxidizing gas under compression at a selected temperature. This innovative process results in a continuous aluminum oxide coating that reduces chromium volatility and mitigates chemical interaction between glass seals and steel components during exposures at extremely high temperatures (up to 800 degrees Celsius in lab tests).

The process also eliminates the need for separate heat treatments or post-firing heat and cleaning treatments as well as the use of expensive materials. The approach could be used for low-cost manufacturing of high-temperature electrochemical devices.

ADVANTAGES

- Applies a continuous protective coating on already assembled materials, saving process steps and speeding manufacturing
- Remains stable over time at high temperatures (up to 800 degrees Celsius)
- Prevents or minimizes release of volatile metals such as chromium, which can reduce performance of electrochemical devices
- Is more economical and efficient than conventional coating approaches

RELATED LINKS

- **"Poster: Dual Interconnect Coatings for Planar SOFC Stacks"**
  Choi J, J Stevenson, K Weil, Y Chou, Z Yang, and G Xia. 2010. Presented at the 11th Annual Solid State Energy Conversion Alliance Workshop.
  http://www.netl.doe.gov/publications/proceedings/10/seca/Abstracts/Choi_Poster.pdf
- **"Journal Article: Development of MnCoO coating with new aluminizing process for planar SOFC stacks."**
  Choi J, K Weil, Y Chou, J Stevenson, and Z Yang. 2010. International Journal of Hydrogen Energy 36(7):4549-4556. DOI:10.1016/j.ihydene.2010.04.110.
  http://www.sciencedirect.com/science/article/pii/S0360319910008128
- **"Report: Investigation of AISI 441 Ferritic Stainless Steel and Development of Spinel Coatings for SOFC Interconnect Applications"**
  Yang Z, G Xia, C Wang, Z Nie, J Templeton, J Stevenson, and P Singh. 2008. PNNL-17568, Pacific Northwest National Laboratory, Richland, Washington.
  http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-17568.pdf
- **"Presentation: Solid Oxide Fuel Cell Materials Development at PNNL"**
  Stevenson J, G Xia, Y Chou, J Hardy, D Reed, O Marina, E Stephens, J Choi, J Templeton, C Coyle, Z Nie, X Li, W Voldrich, E Riel, and M Khaleel. 2012. 2012 Fuel Cell Seminar, Uncasville, CT
  http://fuelcellseminar.com/wp-content/uploads/sta42-2.pdf
- **"Journal Article: Long-term oxidation behavior of spinel-coated ferritic stainless steel for solid oxide fuel cell interconnect applications"**
  Stevenson J, Z Yang, G Xia, Z Nie, and J Templeton. 2013. Journal of Power Sources 231:256-263. DOI:10.1016/j.jpowsour.2013.01.033.
  http://www.sciencedirect.com/science/article/pii/S0378775313000566

PATENTS & INTELLECTUAL PROPERTY

- 9,178,240

TECHNOLOGY PORTFOLIO(S)

- Fuel Cells

PORTENTIAL INDUSTRY APPLICATION(S)

- Aerospace & Defense
- Automotive & Transportation
- Energy & Utilities
- Manufacturing & Warehousing

CONTACT

Jennifer J. Hodas
Pacific Northwest National Laboratory
(509) 372-6960
jennifer.hodas@pnnl.gov
http://availabletechnologies.pnnl.gov