Workshop on Fe-Based ODS Alloys - Role and Future Applications -

Fred M. Glaser

Advanced Research Program Manager

University of California at San Diego, California
November 17, 2010

U.S. DEPARTMENT OF ENERGY

Materials Program Goals

- *Development of a technology base in the synthesis, processing, life-cycle analysis, and performance characterization of advanced materials.*
- *Development of new materials that have the potential to improve the performance and/or reduce the cost of existing fossil fuel technologies.*
- *Development of materials for new systems and capabilities.*

A Disciplined Approach is Being Used to Systematically Address Materials Issues

- ***Commitment to long-range R&D***
- ***Cross-cutting approach***
- ***Extend the Envelope of Materials Performance***
- ***Team where possible with Other DOE Programs***
  - *BES*
  - *EERE*
- ***National Laboratory/Industry/University Collaborations in Past 10 Years***
  - *Seven National Laboratories*
  - *Thirty Universities*
  - *Fifty Industrial/Not-for-Profit Research Institutes*

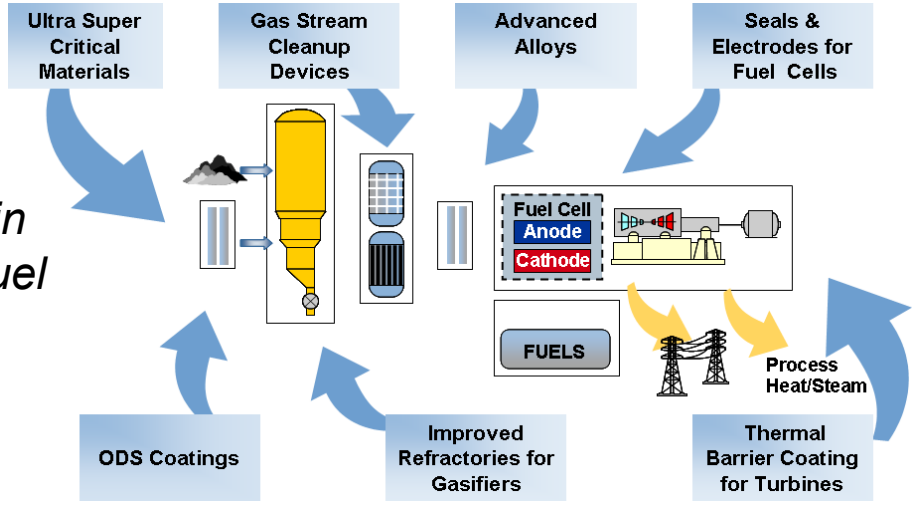
High Performance Materials Research Areas

- ***New Alloys*** - *Increase temperature capability of alloys for use in specific components through developments in composition, microstructure, and properties.*

- ***Functional Materials*** - *Special requirements of materials for specific conditions such as those encountered in hot gas filtration, gas separation, and fuel cell systems.*

- ***Coatings & Protection of Materials*** - *Develop the design, application, and performance criteria for coatings to protect materials from the high-temperature corrosive environments encountered in advanced fossil energy plants.*

- ***Breakthrough Materials*** - *Explore materials development with temperature/strength capabilities beyond those currently available.*



- ***Ultra Supercritical Materials*** – *Develop materials technologies for advanced steam cycles in coal-based power plants to operate at steam conditions of up to 760°C (1400°F) and 5,000 psi .*

Why ODS Alloys?

- **Class of materials with exceptional characteristics, Opportunity for step change in performance of existing and new plant components**
- **The FeCrAl ODS ferritic steels exhibit excellent creep strength at hi temps and have exceptional resistance to hi temp degradation**
- **Not only a coating, it can also be pressed into sheet; also made into heat exchanger tubes**
- **Applications considered: Hi temp heat exchangers for indirect heating of steam or hydrogen for gasification, for fuel nozzles and sheet for combustor cans for syngas fired gas turbines, SH tubes for steam boilers, steam turbine blades and vanes**
- **Challenges to practical application: need better joining techniques, need better processing techniques to improve strength of tubes, need to improve oxidation resistance**
- **We're examining it as a new material that may have some of the same benefits as more expensive Ni based alloys but at a much cheaper cost**
- **Need to re-establish a viable ODS alloy manufacturing capability.**

DOE/FE Support of ODS Alloy Development

- ***At least a 15 year history of funded R&D work for Fossil Energy applications***
  - *ODS tubing for high temperature/low pressure air heaters in mixed Rankine/Brayton cycles (Combustion 2000)*
  - *ODS tubing for ethylene production furnaces*
  - *ODS parts for gas turbines*
  - *Joining technologies for ODS alloys*
  - *Microstructure modifications to improve mechanical properties*
  - *New ODS alloy compositions*
  - *Materials characterization/oxidation testing*

- ***DOE/NETL maintains an active program on iron based ODS alloys***

Current NETL Support of ODS Alloys Development

- ***In FY 2010 NETL supported projects which focused on iron based alloys***
  - *Powder processing*
  - *Microstructure control*
  - *Characterization*
  - *Joining/welding technologies*

- ***ODS alloys were also included in projects whose focus was on oxidation/corrosion behavior of materials for FE applications***

NETL ODS Project Portfolio (FY 2010)

	Project Title or Focus	Lead Performer
	Qualification of New, Commercial ODS Alloys for use in Advanced FE Processes	*ORNL*
	Friction Stir Welding of ODS and Nickel Alloys	*PNNL*
	Reactive Gas Atomization of ODS Powders	*Ames National Lab*
	Solid State Joining of ODS and Nickel Alloys	*UCSD*
	ODS Powders and Coatings R&D	*West Virginia U.*

Why Are We Here?

- Provide a factual overview of the status of ODS alloys
- Review recent developments
- Learn from past history
- Assess the potential applicability of ODS alloys to projected needs

It's a New Day – Much Different Than the Previous "ODS Era"

- **Critical needs for higher energy conversion efficiencies in light of fuel availability and security, economics, and limits on CO_2 emissions**
- **Substantial technical progress**
  - **Joining**
  - **Processing know-how available for producing tubes, sheet, and near net shaped (i.e. HIP) products**
  - **Credible prediction of oxidation lifetimes for alumina-forming ODS alloys**
  - **Ability to design, control, characterize at smaller length scales so as to impact macroscopic behaviors**

"Lack of Suppliers" Is Not a Reason to Abandon an Aggressive ODS Agenda

- **Our energy situation demands it**
- **Such reasoning would have kept us in the pre Iron Age**
- **It is up to the technologists and the end users to create the vision, know-how, implementation plans, and economic approaches needed to make it happen**

At this meeting, we should learn from the past, not dwell on it

The Potential of ODS Alloys

Success in manufacturing and processing could result in a step change in the performance of existing and new power plant components

Contact Information

Robert R. Romanosky
304-285-4721
robert.romanosky@netl.doe.gov

NETL
www.netl.doe.gov

Office of Fossil Energy
www.fe.doe.gov

Vito Cedro III
412-386-7406
vito.cedro@netl.doe.gov