ABSTRACT

Title: Novel Nanocrystalline Intermetallic Coatings for Metal Alloys in Coal-fired Environments

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OBJECTIVE

This research program aims to develop a high temperature corrosion resistant coating for metal alloys used in coal-fired environment. The coating consists of *nanocrystalline* intermetallic alloys, specifically iron aluminide (Fe_3Al) and nickel aluminide (NiAl), which are well known for having superior high temperature strength and corrosion resistance. The program will develop *a new and novel process* that combines the advantages of several coating processes including thermal spray, CVD, and PTA cladding to deposit dense, thick, and phase pure intermetallics and their composite coatings. The coatings will be applied on ferritic and austenitic steels and nickel based superalloy substrates.

Overall scope of the proposed program involves: (1) The development of a new process for applying nanocrystalline intermetallic alloy based coatings, and (2) The testing of the coatings in a laboratory simulated coal-fired environment. The objective is to develop a new coating technology, that has superior corrosion resistance and creep strength at high temperatures than the existing coating technologies, for advanced coal-fired power generation systems.

ACCOMPLISHMENTS TO DATE

A coating unit, as well as the apparatus for evaluating the corrosion resistance of coatings at both steam-side and fire-side environments, has been set up and used for the project. Thick, dense and phase pure iron aluminide (Fe_3Al) coatings have been successfully obtained on steel substrates. Microscopic observations of the coating-substrate interface area indicate excellent metallurgical bonding between coating and substrate, resulting in an excellent coating-substrate bonding strength measured by 3-point bending tests. Corrosion resistance tests simulating steam-side and fire-side environments show that iron aluminide coatings have superior corrosion resistance in both environments. These experimental results indicate that iron aluminide coatings should be a good candidate for advanced coal-fired power generation systems.

FUTURE WORK

- Conducts field tests to evaluate the practical performance of Fe_3Al coated stainless steel pipes in power plant.
- Conducts coating tests to obtain Fe_3Al coatings by reaction synthesis.
- Conducts NiAl coating tests and then compares its corrosion resistance with Fe_3Al coating.

LIST OF PAPER PUBLISHED, U.S. PATENT/PATENT APPLICATION(S), CONFERENCE PRESENTATIONS, AWARDS RECEIVED AS A RESULT OF SUPPORTED RESEARCH,

None to date.

STUDENTS SUPPORTED UNDER THIS GRANT

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