Degradation Resistance of FeCrAl Alloys in the Entire Nuclear Fuel Cycle.

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ABSTRACT
Electricity originating from nuclear energy accounts for over fifty percent of the clean energy consumed in the US. Civilian nuclear power plants have been using the same structural materials for nearly seventy years. Since the Fukushima accidents in March 2011, the international nuclear materials community is engaged in finding newer materials for light water reactors fuels that will make the nuclear power stations safer to operate. These materials include coatings for zircaloy cladding, monolithic alloys such as iron-chromium-aluminum (FeCrAl), and ceramics such as silicon carbide. General Electric and Oak Ridge National Laboratory are developing FeCrAl or IronClad for nuclear fuel pellets cladding. This newly proposed monolithic cladding needs to perform well in the entire fuel cycle, from production, to normal operation conditions, under design basis and beyond design basis accident conditions, under used fuel storage and final disposition. The adaptable resistance of FeCrAl IronClad in each stage of the fuel cycle will be explained and quantified. Under wet conditions and in ambient humid air, the FeCrAl offers protection to corrosion by the development of a chromium oxide on the surface. Under accident condition at temperatures lower than 1000°C, the protection is also by chromia but at temperatures higher than 1000°C, in steam and air, the protection is by alumina.

Keywords: Nuclear fuel, Cladding, FeCrAl, Normal Operation, Accident, Hydrogen

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