

Coating Down Selection for Fluoride-Salt-Cooled High-Temperature Reactor

Steven Huang, Micah Hackett, George Young and Henry Kim
Kairos Power LLC
707 W. Tower Ave, Alameda, CA 94501

ABSTRACT

Tritium management is an important issue for the Kairos Power Fluoride-Salt-Cooled High-Temperature Reactor (KP-FHR) because radioactive tritium is produced due to neutron transmutation in flibe. A target design goal is to maintain environmental releases of tritium at or below the levels of current commercial PWRs, or about 800 Ci per GWe-year. The tritium management strategy development program started at Kairos Power identifies and develops coatings or claddings to provide optimal corrosion resistance as well as tritium permeation barriers for the anticipated service lifetime under service conditions in the KP-FHR. Coating types currently under investigation include aluminide/alumina for oxidizing nitrate salt and nickel, tungsten, carbide, and carburization surface treatments for reducing flibe salt. These surface modifications are assessed based on characterization analysis, adhesion to the 316SS substrate after thermal cycling testing between 25°C to 800°C, and resistance to corrosion attack after 1000 hr testing in flibe or nitrate salts as a first round for coating down selection. Another screening criteria is testing of deuterium gas permeation for each coating's resistance to permeation of hydrogen isotopes, which will be evaluated as second round for coating down selection prior to selecting specific coatings for tritium permeation testing under radiation in flibe salt. The radiation tests for tritium permeation analysis in flibe will also allow for an analysis of corrosion in both high temperature flibe and irradiation. This presentation will show coating characterization analysis, thermal cycling results and analysis, and corrosion testing results and analysis for a better understanding of the metallurgical and mechanical integrity with the 316SS substrate as well as coating chemical stability in high temperature flibe and nitrate salts.