U.S. DEPARTMENT OF ENERGY
INTERNATIONAL NUCLEAR ENERGY RESEARCH INITIATIVE
DOE/ROK

ABSTRACT

Development of Structural Materials to Enable the Electrochemical Reduction of Spent Oxide Nuclear Fuel in a Molten Salt Electrolyte

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This ANL- and KAERI-led collaborative project is designed to develop advanced structural materials to enable the electrolytic reduction of spent oxide nuclear fuel in a molten salt electrolyte. This will include the selection and testing of commercial alloys and ceramics as well as the engineering and testing of customized materials systems.

The electrolytic reduction of spent oxide fuel involves the liberation of oxygen in a molten LiCl electrolyte, which results in a chemically aggressive environment that is too corrosive for typical structural materials. Even so, the electrochemical process vessel, structural cell components, and the electrical supply materials must each be resilient in the presence of oxygen, the molten salt components, and various impurities at 650ºC to enable high processing rates and an extended service life.

The goals of this program are to:

1. Assess and select candidate materials for service in the electrolytic reduction process vessel.

2. Develop new candidate material systems (e.g., functional barrier coatings) for service in the electrochemical reduction process vessel.

This project provides a necessary component to the implementation of electrolytic reduction technology, but it does not deal directly with the mechanisms or operations of the process. The materials solutions developed here will benefit the "Advanced Fuel Cycle Initiative (AFCI) program" of the United States Department of Energy for the reduction of transuranic and fission product oxides and the "Advanced Spent Fuel Conditioning Process (ACP)" of the Korea Atomic Energy Research Institute for the conditioning of spent fuel for long-term storage and eventual disposal. The successful implementation of this project will provide an enabling solution for the effective management of spent fuel, and contribute to the establishment of a nuclear fuel cycle technology that is proliferation resistant and cost effective.

This project is proposed as collaboration between Argonne National Laboratory (ANL) and the Korea Atomic Energy Research Institute (KAERI). The primary contributing organizations within the two parties will be the Chemical Technology Division at ANL and the Advanced Spent Fuel Conditioning Process R&D group at KAERI.