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INTERNATIONAL NUCLEAR ENERGY RESEARCH INITIATIVE
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ABSTRACT

Characterization of Nuclear Waste Forms and their Corrosion Products

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The objective of this project is to understand and describe the conditions for the formation and the overall effects of altered or secondary phases on the behaviour of waste form (spent fuel and/or conditioning matrix) during storage and/or in contact with groundwater. The main processes investigated are the development of waste alteration caused by large accumulation of alpha decay damage (structural, property changes), the formation of secondary phases on the waste form surface and its effect on the waste corrosion behaviour (e.g. corrosion rate, formation of layers blocking further corrosion on the waste form surface, etc.).

1) Monitor the effects of radiation damage accumulation through measurement of relevant quantities/properties (e.g. lattice parameter, macroscopic swelling, hardness, thermophysical properties, etc.) and through microstructure characterization (e.g. TEM). Investigate recovery mechanisms. Study the accumulation/release behaviour of He in different materials (comparison among irradiated fuels and alpha-doped fuels/matrices).

2) Evaluate possible relationships between observed property changes and corrosion behaviour through experiments of aqueous corrosion of "aged" materials (e.g. preferntial etching sites, isotopic fractions of released actinides, etc.).

3) Examine corrosion mechanisms and characterize solid corrosion products formed during the aqueous alteration of spent nuclear fuel (e.g., using X-ray photoelectron spectroscopy, TEM-EELS, SEM-EDS, XRD). Determine the fates of various radionuclides following their release from altered spent fuel, especially in terms of secondary phase formation and co-precipitation phenomena. Characterize re-precipitated phases on leached surfaces in terms of composition and potential effects on corrosion.

The relevant experimental capabilities for micro and macro structural analysis of the E.U. and U.S. partners will be applied to the above mentioned fuel investigations. Experimental setups and data obtained will be jointly discussed. This will include the possible exchange of suitable samples (e.g. "alpha-doped" materials) for full characterization by the U.S. and E.U. facilities, or the acquisition of suitable samples.