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# Corrosion of 316 SS waste canister and Zircaloy-4 cladding in contact with $UO_2$ under conditions relevant to a Deep Geological Repository

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316 stainless steel (316 SS) and Zircaloy-4 are the anticipated materials to be used as waste canister material and cladding material for the disposal of spent nuclear fuel (SNF) in a deep geological repository (DGR) due to their corrosion resisting capabilities. Here we present the most recent results of our NEUP project Redox Chemistry of UO2 under Repository Relevant Conditions in the Presence of Zircaloy and Waste Canister Material.

To obtain baseline information on how each component of the waste package affects the redox conditions of UO2 in a DGR, a bottom-up approach is pursued wherein UO2 pellets were hydrothermally corroded at high temperature and pressures while in contact with either 316 stainless steel (316 SS) acting as the waste canister or Zircaloy-4 acting as the cladding material. Hydrothermal corrosion experiments were conducted both at 150 °C and 250 °C with varying corrosion durations lasting from 1-6 weeks in MilliQ and Mont Terri water. Upon termination of the corrosion experiments, analysis of the formed secondary phases was performed using SEM-EDS, Raman spectroscopy and GI-XRD to discern possible redox mechanisms occurring. Analysis on the corroded materials suggests that the Zircaloy-4 cladding forms zirconium dioxide whereas the 316 SS corrodes to form iron oxides, specifically hematite and magnetite. Cross section analysis by TEM of the corroded UO2 pellets in contact with 316 SS and Zircaloy-4 are currently being performed to gain in-depth insights about the nanocrystalline secondary phases formed at the materials interfaces. Following the identification of the observed secondary phases, thermodynamic modeling using the HCh software will be conducted to complement experimental findings and gain in-depth insights about the developing redox pairs.