Progress on the Application of Metallic Fuels for Actinide Transmutation

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Abstract

Idaho National Laboratory (INL) is developing actinide bearing alloy metallic fuels intended for effecting the transmutation of long-lived isotopes in fast reactor application as part of a partitioning and transmutation strategy. This presentation will report on progress in three areas of this effort: demonstration of the fabrication of fuels under remote (hot cell) conditions directly coupled to the product from the pyroprocessing of spent fuel as part of the Joint Fuel Cycle Studies (JFCS) collaboration with the Korean Atomic Energy Research Institute (KAERI); the chemical sequestration of lanthanide fission products to mitigate fuel-cladding-chemical-interaction (FCCI); and transmission electron microscopy (TEM) and atom probe tomography (APT) studies on the as-cast microstructure of the metallic fuel alloy. For the JFCS efforts, we report on the implementation of the Glove-box Advanced Casting System (GACS) as a prototype casting furnace for eventual installation into the INL Hot Fuel Examination Facility (HFEF) where the recycled fuel will be cast. Results from optimising process parameters with respect to fuel characteristics, americium volatility, materials interaction, and lanthanide fission product carry over distribution will be discussed. With respect to the lanthanide carry over from the pyroprocessing product, encouraging studies on concepts to chemically sequester the FCCI promoting lanthanides within the fuel matrix thus inhibiting migration and interaction with the cladding will be presented. Finally, in relation to advanced modelling and simulation efforts, detailed investigations and interpretation on the nanoscale as-cast microstructure of possible recycle fuel composition containing U, Pu, Am, Np as well as carry-over lanthanide species will be discussed. These studies are important for establishing the initial conditions from which advanced physics based fuel performance codes will run.