PURDUE UNIVERSITY | School of Nuclear Engineering

Nuclear Engineering Seminar

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Fission Products Retention and Chemical Interactions in Sodium-cooled Fast Reactors

Abstract

Conventionally, in light water reactors (LWRs), a critical concern is the release of radionuclides, which are then retained in the primary coolant, followed by plate-out on structural materials and subsequent degradation of these materials. Models along with experimental validation have been developed to assess this problem. The assessment performed for LWRs does not translate to metallic fuels in sodium-cooled fast reactors (SFRs), though. Radionuclide release in the primary sodium due to fuel and cladding failure is one of the many issues associated with the development and deployment of SFRs. The speaker will present fundamental studies about the radionuclides retention capabilities and the consequences of radionuclides release into the primary sodium coolant. In a fuel damage accident, most fission fragments might release from the failed fuel into the primary sodium loop and remained within or absorbed by the sodium-wetted metal surfaces, while the others flow with the helium cover gas over the liquid sodium in the reactor pool to gaseous storage tanks. In the primary sodium coolant, due to the high retention of fission products, the chemical interactions of radionuclides with structural materials, including cladding, primary coolant pumps, intermediate heat exchangers, and reactor vessel are of critical concern. Since the majority of core components are constructed using type-300 stainless steel, the corrosion products include 54Mn, 58Co, 60Co, having long half-lives. The plate-out of fission products interact with the structural materials, degrading the mechanical robustness of structures.

Prof. Yi Xie is an Assistant Professor in the School of Nuclear Engineering at Purdue University and joined Purdue in June, 2020. She worked as a Research Scientist at Idaho National Laboratory (INL), the division of advanced nuclear fuel development. She was the inaugural Glenn T. Seaborg Distinguished Postdoctoral Associate at INL, received the Ph.D. degree in Nuclear Engineering at The Ohio State University, and the B.E. degree at University of Science and Technology of China. She has more than 30 journal papers with most of them first-authored. Her research interests include corrosion in nuclear systems, advanced nuclear fuel, sensor materials and technology development, advanced sintering technology development, and geological repositories of radioactive waste. The research focuses on fundamental understanding and engineering applications of nuclear materials. Prof. Xie is interested at materials used on the nuclear reactor and fuel cycling system, exposed to extreme environments under irradiation and complex chemistry conditions. She designed and developed multiple complex test systems for nuclear materials study. She has extensive experience in advanced fuel fabrication, characterization, and development, based on her employment at INL and Purdue University.