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Lithium Aluminate Pellet Irradiation Experiment

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Lithium aluminate (i.e., y-LiAlO2) pellets were subjected to neutron irradiation during the TMIST-3 in-reactor experiment, which was designed to evaluate tritium release rate and speciation from various pellet designs. The TMIST-3 experiment consists of a short-term and a long-term test train to study the effects of burnup, burnup rate, and time on tritium release rate and speciation. The short-term test train, TMIST-3A, was irradiated for a total of 8 cycles in the Advanced Test Reactor (ATR) at Idaho National Laboratory between September 2016 and January 2019 to achieve ~ 350 effective full power days (EFPD) at 23 MWth. The long-term test train, TMIST-3B, was subsequently irradiated for a total of 15 cycles in the ATR between November 2019 and October 2025 to achieve ~700 EFPD at 23 MWth. Pellets irradiated in the TMIST-3 test trains are contained separately in either "open"(i.e., flow-through) or "closed"(i.e., hermetically sealed) capsules. Pellets contained within closed capsules will be evaluated during post-irradiation examination to assess the fractionation of tritium released as either elemental tritium (i.e., 3H2) or tritiated water vapor (3H2O). However, the focus of this presentation will be on results obtained from the open capsules of TMIST-3B, which provide in-situ measurement of tritium release via an ex-reactor tritium monitoring system. Details of the TMIST-3B test train layout will be provided as well as an overview of the open and closed capsule designs. A total of 19 capsules were included in TMIST-3B and six of them were open capsules with dedicated sweep gas lines flowing to an ex-reactor tritium monitoring system adjacent to the ATR. This ex-reactor system will be described as well as the various pellet designs considered in this study. Different pellet designs were included in TMIST-3 to evaluate the influence of microstructure and pellet microstructures were tailored to possess specified grain sizes and pore distributions. In addition to these lithium aluminate-based pellets, a unique cermet pellet consisting of lithium aluminate particles dispersed within a zirconium matrix was also included among the pellet designs of TMIST-3. Results of tritium release rate measurements obtained from TMIST-3B for these different pellet designs will be presented and compared.

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