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Analysis of Fission Gas Release under Post Irradiation Annealing Conditions

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Abstract

Fission gas release under post irradiation annealing condition is analyzed using an empirical fission gas release model for transient conditions. Based on the amount of fission gas retained in the matrix and grain boundary, burst release of fission gas during temperature increase, which is considered to take place via grain boundary separation due to microcracking, is described. Since this mechanism requires certain threshold thermal stress to cause pellet cracking, an experimentally measured threshold temperature is used to activate gas release via microcracking. In addition, diffusional release during holding period at high temperature is considered. The verification of the model has been performed using the data obtained from thermal annealing experiments of BWR fuel pellets base-irradiated to 628 MWd/kgU in a commercial reactor. Comparison between the measured and calculated results showed that, to fit the measured data, not only gas atoms retained in the grain boundaries but also some of those in matrices contributed to the burst release during temperature increase. This implies that the discrepancy comes from the difference in diffusion coefficients between the one used in the present calculation and the one in the specimen. The gas inventory in the grain boundary available for release depends on diffusion coefficient. In addition, it was found that even just after the burst release, diffusional release occurs due to the very rapid diffusion of gas atoms from the matrix to the grain boundary.