Microhardness and Young's modulus of high burn-up UO2 fuel

Abstract:
Vickers microhardness (HV0.1) and Young's modulus (E) measurements of LWR UO2 fuel at burn-up ≥60 GWd/tHM are presented. Their ratio HV0.1/E was found constant in the range 60–110 GWd/tHM. From the ratio and the microhardness values vs porosity, the Young's modulus dependence on porosity was derived and extended to the full radial profile, including the high burn-up structure (HBS). The dependence is well represented by a linear correlation. The data were compared to fuel performance codes correlations. A burn-up dependent factor was introduced in the Young's modulus expression. The modifications extend the experimental validation range of the TRANSURANUS correlation from un-irradiated to irradiated UO2 and up to 20% porosity. First simulations of LWR fuel rod irradiations were performed in order to illustrate the impact on fuel performance. In the specific cases selected, the simulations suggest a limited effect of the Young's modulus decrease due to burn-up on integral fuel performance.

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