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STATISTICAL INVESTIGATION OF RADIATION-INDUCED POROSITY IN BN FUEL CLADDINGS USING SCANNING ELECTRON MICROSCOPY

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Radiation-induced swelling of claddings is one of the factors limiting service life of fast reactor fuel assemblies. Hydrostatic weighing and transmission electron microscopy are conventional porosity investigation methods.
Hydrostatic weighing is advantageous in terms of the determination radiation porosity integral characteristics, specifically cladding dimensional change after operation in the reactor. However, at low swelling levels (tenths of a percent) the method accuracy is comparable to the measurement error, and its application at the swelling initial stage is ineffective.
Transmission electron microscopy is used to determine quantitative characteristics of radiation porosity, such as size and concentration of radiation-induced voids. One of the main disadvantages of the method is its locality and complexity of sample preparation. High resolution of transmission electron microscope allows to observe even small voids (⊠1 nm) in the foil up to 150 nm thick. Nevertheless, observation of voids exceeding the foil thickness in diameter is complicated, and the reliability of quantitative assessment of large void concentration is quite low.
The paper aims to apply scanning electron microscopy having both method advantages in the radiation porosity investigation. Significant areas of the examined surface together with detection of voids from 10 nm give statistically representative data. Therefore it is possible to obtain information on radiation porosity macroscopic nonuniformity in structural elements subjected to the examination.
The paper presents methodological aspects of radiation porosity investigation with scanning electron microscopy: different modes of sample surface preparation and identification of electron beam optimal parameters. SEM and TEM quantitative results are compared, and radiation porosity nonuniformity in claddings is demonstrated.

Country/Int. Organization

Joint Stock Company “Institute of Nuclear Materials”

Primary author: Mr PASTUKHOV, Vladimir (Joint Stock Company ”Institute of Nuclear Materials”)

Co-authors: PORTNYKH, Irina (Joint Stock Company ”Institute of Nuclear Materials”); Mr AVERIN, Sergey (Joint Stock Company ”Institute of Nuclear Materials”)

Presenter: Mr PASTUKHOV, Vladimir (Joint Stock Company ”Institute of Nuclear Materials”)

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