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Results of monitoring, using high-resolution neutron diffraction, of radiation-induced damages in claddings of fuel pins after their performance in the reactor BN-600 as a ground for prolongation of their life expectancy

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Fast neutron irradiation gives rise to rather complex processes developing in the fuel element claddings that lower their technical characteristics and restrict time of safe exploitation. Neutron diffraction studies open up a possibility to monitor them even at a stage of incubation period and thereby to promote development of reliable methods for life expectancy prolongation of the reactor components. An important advantage of these methods is minimal manipulations needed for work with high radioactive samples.
We carried out neutron-diffraction studies of the samples prepared from the fuel elements claddings made of austenitic steel EK-164 both in the initial state and after real exploitation in different parts of the reactor BN-600 core at temperatures (360 –630) C up to the dose of 75 dpa. It was found that the samples cut from the fuel elements of different lots had small distinctions in their structure state (inner stresses, texture, dislocation density). It was confirmed that up to the highest fluences in the study, the FCC lattice is retained, with the microstate depending of three parameters: fluence, neutron flux density and temperature. Our neutron diffraction data saying that maximal concentration of defects takes place at high fluence within the core part with the temperature of (400-550) C are in agreement with data on the fuel element claddings swelling. At the same time low neutron flux densities, temperature about 375 C and dose up to 10 dpa result in the annealing of initial defects and decrease of microstresses (dislocation densities). It is interesting that within the core part at a temperature of 628 C and 75 dpa defect concentration is shown to decrease again, down to the level being lower initial.
Now we continue our studies of the claddings materials up to 105 dpa.
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