

ABSTRACTLong-Term Radiation Effects on Graphite*

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A large number of experimental and nuclear graphites were studied to determine the long-term irradiation behavior of (1) graphites presently in use in nuclear reactors, and (2) graphites having characteristics which will provide information for development of potentially "dimensionally-stable" graphites. The tests were conducted at irradiation temperatures from 300 to 1200°C under neutron exposures ranging up to 2.4×10^{22} neutrons per cm^2 ($E > 0.18$ MeV). Graphites studied included conventional-coke graphites (CSF, TSGBF); needle-coke graphites (NC7, NC8); raw-coke graphites (63-16, H313); additive graphites (V_2O_3 , Al_4C_3); binderless graphites (63-38); isotropic graphites (JOZ, H319, 9345); and speciality graphites (DS13, GN, EP1924 HP). The properties studied were dimensional change, change in volume, electrical resistivity, Young's modulus, and CTE, with the emphasis on dimensional changes. For samples of the nuclear graphites cut in the direction transverse to the extrusion axis the length changes show a contraction followed by an expansion which at the high exposures and/or high temperatures has exceeded 20%. In the parallel direction the contraction observed initially has also gone through a turnaround and in one case has become a net expansion. At the temperatures from 300 to 800°C and at constant exposure the contractions are less but the expansions more as the temperature increases. Above 800°C the contractions are much larger but the expansions occur very rapidly and are also larger. The "improved" graphites offer considerable potential for long-term use since they show much smaller dimensional changes at equivalent neutron exposures.

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