Effects of Fast Neutron Irradiation on State-of-the-Art Nb_3Sn Wires

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We present results of an extensive neutron irradiation study involving five different types of state-of-the-art Nb_3Sn wires. Short samples were subjected to sequential irradiation in the TRIGA Mark-II reactor in Vienna up to a cumulative fast neutron fluence of $2 \cdot 10^{22}$ m^{-2}. Changes in the critical current density J_c as well as in the critical temperature T_c were assessed after each irradiation step by means of SQUID magnetometry. Our results appear to contradict those obtained from irradiation programs conducted in the 1970s and 80s insofar as the fluence at which the peak in J_c occurs is much higher in the examined wires. Contrary to common belief, the increase of J_c results from additional pinning due to irradiation induced defects, whereas the increase of the upper critical field is insignificant. Since neutron irradiation changes both the magnitude and the functional dependence of the critical current density significantly, these results are relevant to the design of Nb_3Sn magnets which have to operate in radiation environments such as particle accelerators and fusion energy devices.