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Neutron irradiation

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For the design of FCC-hh superconducting magnets an increase of the high field critical currents in commercial Nb3Sn wires by about 50 % is required. Feasibility of reaching this target has already been demonstrated by fast neutron irradiation induced defects. In this study, the underlying mechanisms are investigated through combined microstructural and magnetic analysis for realization in an industrial process.

A research reactor was used to irradiate Nb3Sn wires and TEM samples. Micro- and nanostructural examinations of grain geometry, grain boundary morphology, compositional gradients, local texture and defect structure were performed by transmission electron microscopic methods such as HRTEM, EDX, EELS and selected area diffraction before and after irradiation. The results thereof are correlated with superconducting measurements such as transport, magnetometry and scanning Hall probe experiments to determine the global critical current as well as the local critical current density within the subelements.

This study contributes to a better understanding of the influence of irradiation damage and the resulting microstructure on local superconducting properties and ultimately on the macroscopic performance of the superconductor.

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