Critical current density of Nb_3Sn wires after irradiation with 65MeV and 24GeV protons

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Abstract - Industrial Nb_3Sn wires with Ti and Ta additives (RRP process) and with Ta additives (PIT process) with a diameter of 1 mm have been irradiated at room temperature with protons of 65 MeV and of 24 GeV at various fluences up to 1×10^{21} p/m^2. A steady increase of J_c vs. fluence was observed for all the wires up to the highest fluence. The observed increase of J_c at 4.2K in all wires was quite similar in spite of the very different proton energies. With increasing fluence, the radiation induced pinning force was found to increase, the enhancement J_c/J_{co} after 5.04×10^{20} p/m^2 reaching 1.4 for Ta and 1.8 for Ti alloyed wires at 10T. The present results were quantitatively analysed by assuming a radiation induced point pinning mechanism in addition to grain boundary pinning. The results are compared with those of an ongoing neutron irradiation study undertaken on the same Nb_3Sn wires in collaboration with the Atominstitut Vienna. Proton irradiation was found to produce considerably higher damage than neutron irradiation.

Keywords - PIT Nb_3Sn wires, proton irradiation, flux pinning, critical currents, HL-LHC