PL5-INV

Frontiers of Nb_3Sn wire technology

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65 years after its discovery, Nb_3Sn still defends its leading place against HTS in high field applications, like high-resolution NMR spectrometers, fusion magnets and laboratory magnets, and has even regained interest over the past decades pulled by the next Big Science experiments. In particular, the Future Circular Collider at CERN represents the next big potential application as well as a grand challenge for Nb_3Sn superconductors. The goal of a 100 TeV proton-proton collider set by the high-energy physics community has led to a baseline configuration requiring dipoles generating 16 T in a 100 km tunnel. This translates into a requirement of a minimum critical current density of more than 1'500 A/mm^2 at 16 T and 4.2 K, which is substantially beyond state-of-the-art for commercial Nb_3Sn wires. Apart from high critical current density, the stress sensitivity of Nb_3Sn is a parameter of the highest importance for the design of the next generation accelerator magnets, whose large sizes and intense fields will result in unparalleled electromagnetic forces. The aim of this talk is to illustrate the directions in which these technology needs are driving the properties evolution of Nb_3Sn. First, I will introduce the main parameters controlling the achievable transport current density in Nb_3Sn. Emphasis will be given to some recent innovations showing that the potential of the material for future performance upgrades is not yet exhausted. I will also report on what we learned regarding the mechanisms of the wires' irreversible critical current degradation upon mechanical loading and discuss possible strategies towards high-performance Nb_3Sn wires with enhanced stress tolerance.