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Irreversible strain characteristics of technical RHQT Nb3Al superconductors

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In the ITER magnets consisting of Nb3Sn conductors, the magnets are fabricated through the so-called wind & react (W & R) technique. In the W & R process, the conductors are wound prior to the heat treatment to form the Nb3Sn superconducting strands from the non-superconducting ductile precursor ones. Then the heat-treated windings are encased into the radial plate keeping their winding shape as it is. The Nb3Sn strands have lower strain sensitivity, so that the applied bending strain to the Nb3Sn strands should be suppressed as small as possible. However in DEMO reactor magnets whose size becomes much larger than the ITER ones, the problems concerning dimension accuracy and fabrication cost should become much bigger. In this context, the react & wind (R & W) process would have to be considered as a solution to construct the magnets. The Nb3Al strands have small strain sensitivity for Jc characteristics. Hence, they could be one of the alternative conductors for realizing the R & W coil. In the R & W application, the irreversible strain characteristics of the strand should be also an important factor as well as the strain sensitivity. The irreversible strain limit should be an index indicating how much the strand is bendable. Hence in this study, we compared the irreversible strain characteristics of various technical rapid-heating, quenching and transformation-processed (RHQT) Nb3Al strands with a different matrix material and filament diameter.

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