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Wed-Af-Po3.21-10 [76]: Effect of Nb3Sn coarse grains on critical current densities of Internal Tin Nb3Sn strand

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Nb3Sn strand have significant applications in constructing high-field (> 10 T) magnets and has great potential value in the next 20 years. Internal-tin (IT) Nb3Sn strand has been developed by many methods for the future fusion reactor after ITER with low hysteresis loss. However, how to improve the current densities of Nb3Sn strand has been becoming an important problem with the increasing demand for high Jc Nb3Sn strand. In our study, we found that more than double Nb content should be added within Internal Tin Nb3Sn strand and 2˜3 times critical current densities can be enhanced compared with ITER Nb3Sn strand. With this Nb3Sn strand, the phase transition during heat treatment was investigated and new phase (Cu-Nb-Sn) can be produced at 400℃ as the reason of more Nb content added and Cu6Sn5 phase decomposition. The coarse Nb3Sn grains were analyzed and a composite structure (Cu and Nb3Sn) can be produced as Nb element diffusion during Cu-Nb-Sn phase formation. We also found that phase-balance (less Cu-Nb-Sn produced), which can control the formation of Nb3Sn coarse during filaments, can be obtained through element ratio optimization. With this method, coarse grains among filaments can be refined from micron size into nano-size. Effect of varisized coarse grains on the critical current densities was also studied and we found that micron sized Nb3Sn (1˜2 μm) grains reduced the the critical current densities severely.

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