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# Sat-Af-Or4-02: Jelly-Roll Processed Nb3Sn Ultrafine Superconducting Wires

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The National Institute for Materials Science (NIMS) is ongoing the R&D on ultrafine Nb3Sn superconducting wires less than 50 microns in diameter. So far, we have successfully fabricated a kilometer-scale of Nb3Sn ultrafine wire through the bronze process. The starting billet was assembled by 19 Nb rods, a bronze alloy matrix of Cu-14%Sn-0.3%Ti. The outer diameter of the starting billet is 45.2 mm. After the hot extrusion with an extrusion ratio of 9.1, it was cold-drawn from 15.0 mm to 0.05 mm (50 microns) in diameter with intermediate annealing with a reel-to-reel process. Eventually, we obtained over 7,000 m in a piece length without wire breakages. To increase the critical current density, we have tried to fabricate the precursor wires through the Jelly-roll process. Nb and Cu thin foils are overlapped on the pure Sn rod without Ti additive, and then this laminated composite is inserted into the Cu tube with the Nb foil diffusion barrier. The rotary swaging was applied at the beginning of area reduction and then conventional die-drawing was applied. Eventually, we could fabricate the ultrafine Nb3Sn wires with 50 microns in diameter through the Jelly-roll process. According to the microstructure study in transverse cross-section of the 50 microns wire reacted at 675 oC for 48 h, Nb3Sn thick layer was synthesized like a donut ring with 32 microns in outer diameter and 22 microns inner diameter. The fine Nb3Sn grain size of sub-microns and very dense microstructure were obtained. The non-Cu critical current densities at 4.2 K were 1,800 A/mm2 at 12 T and 1,000 A/mm2 at 14 T.
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