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Recent Progress of Nb₃Sn Wires in KSL/JASTEC

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Kobe Steel Ltd. (KSL) has been doing researches of Nb₃Sn wire since the 1980s. Japan Superconductor Technology, Inc. (JASTEC), which belongs to Kobe Steel Group, has been manufacturing superconducting wires and magnets. In respect of the superconducting wires, JASTEC has high production capacity in bronze-processed Nb₃Sn wires and is one of the main supplier of Nb₃Sn strands used for ITER project. To increase J_c , we made the filament diameter finer and improve the heat treatment, and achieved very high performance of non-Cu $J_c = 1200 \text{ A/mm}^2$ at 12 T, 4.2 K by the bronze method.

Recently, according to the assumed specification of the Nb₃Sn for the accelerator magnets of the FCC (Future Circular Collider) planned by CERN (European Organization for Nuclear Research), it is required to achieve extremely high J_c , which is unprecedented, and high RRR (Residual Resistivity Ratio) and small effective filament diameter (d_{eff}).

We have developed high performance Nb₃Sn wire via DT (Distributed Tin) method, which is a type of internal Sn method with single barrier. So far, non-Cu J_c of 1,100 A/mm² at 16 T, 4.2 K has been achieved by reducing Sn diffusion length and optimizing Ti content. The d_{eff} of these samples were approximately 30 to 60 μm . The values of RRR were approximately 350, and RRR after 10% rolling assuming deformation of the cabling were 150 to 200, and no decrease in J_c was observed.

From these results, The DT method has very high potential as a candidate of Nb₃Sn wire for FCC. We will continue to improve J_c by further increasing Nb ratio and optimizing for the Sn diffusion distance, ternary additive elements and heat treatment, etc., for targeting the FCC's specification.

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Superconducting wire, Nb₃Sn, Bronze method, Distributed Tin method

