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P2.100 Demonstration tests of mechanical lap and edge joints of 10-kA-class STARS conductors

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Segment-fabrication of high-temperature superconducting (HTS) magnet is an attractive concept to solve engineering issues of helical fusion reactor having huge and complex superconducting helical coils. There are two designs as the segment-fabrication: 1) Remountable (demountable) coil option; the entire half-pitch helical coil segments are connected with demountable multi-conductor joints, 2) "Joint-winding" option; one helical-pitch single conductor segments are connected with once-through joints. In those designs, HTS conductors consisting of simply stacked REBCO (Rare-earth Barium Copper Oxide) tapes embedded in copper and stainless-steel jackets are used and the conductor is named STARS (Stacked Tapes Assembled in Rigid Structure) conductor. We have developed mechanical edge joint and bridge-type mechanical lap joint of STARS conductors for the former and the latter designs, respectively. In our previous study, we have already achieved 80 nano-ohms using the mechanical edge joint of 1-kA-class STARS conductors at 77 K. The next target of the edge joint is achieving 1 nano-ohm using 10-kA-class conductors at 4.2 K. Another study has also achieved 2 nano-ohms using the bridge-type mechanical lap joint of 100-kA-class STARS conductors at 4.2 K. However, it took over a half day to fabricate the joint because the joint piece was not integrated but just individual REBCO tapes.

In this study, we fabricated mechanical edge joint and bridge-type mechanical lap joint of 10-kA-class STARS conductors to demonstrate their low joint resistance and quick fabrication compared to previous studies. An integrated joint piece was newly introduced to shorten the fabrication process of bridge-type mechanical lap joint, which might make the fabrication time to be less than 3 hours per one joint. The joint resistance was evaluated at 77 K and 4.2 K using liquid nitrogen and liquid helium cryostat. The detail of the conductor geometry and results are presented.

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