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Mechanical strength evaluation of Yoroi-coil structured non-circular REBCO pancake coil in high magnetic field

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In order to achieve high intensity and compact multifunctional cyclotron, the behavior of the non-circular coil in a high magnetic field at 4.2 K, and the reinforcement of it have been investigated. Two types of isosceles triangle shaped double-pancake coils; a coil with reinforcement due to Yoroi-coil (Y-based oxide superconductor and reinforcing outer integrated coil) structure and a coil without reinforcement, were manufactured and observed their behaviors when current was applied to the each coil in a high magnetic field. The latter examination without reinforcement in 10 T external magnetic field showed that the superconducting property of the coil was lost and the flow resistance was observed when the applied current exceeded 160 A. Unbalanced and non-uniform electromagnetic stress affects the superconductor in the non-circular coil because the radius of the triangle shaped coil varies. The coil was disassembled after the hoop stress test, and it was found that the superconducting tape was plastically deformed and bent at the apexes of the triangle by the strong stress. The reinforced coil by Yoroi-coil structure was applied up to 300 A in a magnetic field of 14T. A voltage of 0.3 mV was observed when the coil current was 277 A, and excitation was terminated when voltage reached 0.6 mV at 300 A. The coil windings after the test were also observed, and the turbulence of the windings was significantly smaller than that of the coil without reinforcement. It was clarified that the Yoroi-coil structure has the effect of reducing the electromagnetic force affecting a coil winding even in a non-circular coil. Details of the experimental results will be reported.

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