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M4Or1A-02: [Invited] Spiral Copper-plated Striated Coated-conductor Cable at Kyoto University

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The wide, 4 mm typically, the monofilament shape of a usual coated conductor causes large magnetization, which could deteriorate the field quality of an accelerator magnet. If we filamentize a coated conductor and insulate its filaments one another, we can reduce the magnetization of the coated conductor. However, such a coated conductor, in which no current can be shared among filaments, is not practical, considering that defects localized longitudinally and laterally are unavoidable in any coated conductor. Just one local defect in each narrow filament could block its current, and, then, a long coated conductor consisting of such filaments cannot carry any current, i.e. its end-to-end critical current could be zero. If we plate the entire group of filaments with copper, the copper could allow current sharing to improve the robustness against local defects. Similar to low Tc superconductors in which filaments are embedded in copper, note that the assembly of filaments (a coated conductor) must be twisted to decouple filaments electromagnetically against transverse magnetic fields. Otherwise, filaments coupled electromagnetically behave like a monofilament coated conductor, and the magnetization cannot be reduced. However, we can easily imagine that twisting a tape-shape coated conductor is far from practical. We have been proposing winding spirally a copper-plated multifilament (striated) coated conductor on a round core instead of twisting it. The spiral geometry plays an equivalent role to the twist geometry in order to decouple filaments. We wound spirally copper-plated coated conductors on a core in multiple layers to form a cable, which can carry a high current. We name this cable SCSC cable, standing for Spiral Copper-plated Striated Coated-conductor cable. We measured magnetization losses using short samples to confirm that the coupling time constants could be reduced by spiraling and that the magnetization losses could be reduced. We also confirmed that a four-layer cable sample could carry a reasonable current, which was equal to the sum of the critical currents consisting of the cable sample. A reel-to-reel cabling machine was installed at Kyoto University, and, now, we can fabricate long cables using it. The latest results of the research and development of the SCSC cables will be reported in the presentation.

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