Development of High Strength Pancake Coil with Stress Controlling Structure by REBCO Coated Conductor

Shigeo Nagaya, Tomonori Watanabe, Tsutomu Tamada, Mitsuhito Naruse, Naoji Kashima, Toshio Katagiri, Naoki Hirano, Satoshi Awaji, Hidetoshi Oguro and Atsushi Ishiyama

Abstract - High strength against electromagnetic force is required for high magnetic field and large capacity coil in order to develop large-capacity superconducting magnetic energy storage (SMES) system for electric power system control. And suppression of delaminating of Yttrium (Y) based coated conductor in a coil is also required to manufacture the highly reliable and durable superconducting coil. Insulating coating, using liquid resin of low-temperature-curable-polyamide, was developed and showed durability at very low temperature without deterioration of transport properties of superconducting wire in a coil. Combining paraffin molding, delaminating and deterioration of transport properties of superconducting wire were not also observed in a coil. These insulating techniques were applied to the pancake coil, in which superconducting wire and the reinforcing outer plates of the coil withstand electromagnetic force. The double pancake coil of this coil structure, called "Yoroi-coil; Y-based oxide superconductor and reinforcing outer integrated coil" was prepared and verified durability against electromagnetic force by hoop stress test. The coil achieved 1.5 kA transporting at 4.2 K in 8 T back-up magnetic field without the degradation of transport properties. Maximum hoop stress at the hoop stress test reached 1.7 GPa, based on the calculations. This result was confirmed that Yoroi-coil structure has a capability to withstand the large hoop stress, which exceeded the tensile strength of Y-based coated conductors, and bring out highly durable and reliable superconducting coils.

Keywords - Hoop stress, Yoroi-coil, SMES coil, Yttrium based coated conductor.

IEEE/CSC & ESAS EUROPEAN SUPERCONDUCTIVITY NEWS FORUM, No. 22, October/November 2012. ESNF Reference No.ST305 Category 6. The published version of this preprint appeared in *IEEE Transactions on Applied Superconductivity* 23, 4601204 (June 2013).