Contribution ID: **109** Contribution code: **TUE-PO1-705-05** Type: **Poster**

Experimental study on quench protection method for HTS coil that uses Cu tape co-wound with HTS tape

Tuesday 16 November 2021 13:15 (20 minutes)

The authors'group is investigating a quench protection method for HTS coils that use Cu tape co-wound with HTS tape. In this method, the voltage V_s across the resistive zone in the HTS coil is monitored by measuring the voltage difference between the HTS coil and the co-wound Cu tape coil in normal operation. When V_s exceeds the quench detection voltage, the HTS coil is disconnected from the power supply and the energy stored in the HTS coil is dumped into a dump resistor R_1. At the same time, a voltage is induced in the co-wound Cu coil and a switch to connect the co-wound coil to a resister R_2 is closed to induce a current in the co-wound coil. Then, a part of the currents of the HTS coil is quickly transferred to the co-wound Cu tape coil because of the tight magnetic coupling of the both coils, and the HTS coil current is decreased rapidly to a certain value just after the quench protection sequence starts. Thus, the hot spot temperature is reduced. In the authors'previous work, effectiveness of the quench protection method was shown by a numerical simulation analysis. In this work, the method was investigated by simulation experiments using small scale test pancake coils co-wound with YBCO wire and Cu tape. Current patterns of the YBCO coil and co-wound Cu coil of a model magnet at a quench event were calculated for the case that this quench protection method was applied. In the experiment, the same patterns of the currents were applied to the quenching test coils by controllable current supplies. Experimental results showed that the quench protection method was effective to reduce the hot-spot temperature, when a proper value of $= R_1/R_2$ was selected.

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Session Classification: TUE-PO1-705 Quench Detection I