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## **Tue-Af-Po2.14-04 [4]: The Effect of Turn-to-Turn Contact Resistance on the Electrical Characteristic and Thermal Stability of 2G HTS Pancake Coils**

*Tuesday 24 September 2019 14:00 (2 hours)*

This paper presents our analysis of the electromagnetic characteristic and thermal stability of 2G high-temperature superconductor (HTS) pancake coils depending on the turn-to-turn contact resistance. Numerical simulations for investigating electromagnetic characteristic, mechanical stress and thermal stability of HTS pancake coils were performed by taking into account different contact resistance between turns based on equivalent circuit model and finite element analysis in COMSOL. Since the electromagnetic characteristics of HTS coil highly depend on the temperature, the current density and the magnetic field vector, it is extremely complex to analyze the stability of HTS coils when the current wave, the magnetic field distribution, heat losses and the cooling condition are taken into consideration. The numerical model of YBCO coils based on H-formulation has the problem of highly non-linear behavior, which means that as the temperature of the HTS coils reach normal state, the E-J power law becomes strongly singularity. To avoid the problem, we propose a new definition of current density in YBCO tape, which is a sum of two components in different stage. To validate the simulation results, four HTS pancake coils co-wound respectively with stainless steel, epoxy, Kapton and non-insulation(NI) coil were fabricated and tested. And then contact resistances of HTS coils were measured under different magnet field and frequency. Chargedischarge, sudden-discharge and over-current tests were performed to evaluate performance of coils. Quench test induced by hot spot disturbance during constant current were performed in different conditions immersed in liquid nitrogen. Beside, a parallel resistance method is proposed to decrease contact resistance. Both numerical and experimental results show that turn-to-turn contact resistance can affect characteristics of time constant, ac loss distribution, thermal stability and mechanical stress in HTS coils. From the study, it is believed that as the contact resistance decreases, the electrical stability increases. The obtained results could be useful in designing HTS coil.

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