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Development of quench analysis model for single copper–plated multifilament coated conductor

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High–temperature superconductors (HTSs) still hold some unignorable issues, such as AC losses and its poor robustness against normal transition. For HTS tapes, dividing superconducting layer into filaments by striation shows remarkable effects on reducing AC losses. However, it could deteriorate robustness due to blocking a current sharing among filaments. Thus, plating copper on the entire group of superconductor filaments plays an important role in improving the robustness.
Quench characteristics of copper–plated multifilament coated conductors are so complicated that we hardly can understand it from experiments. In order to evaluate the robustness of such conductors and design the conductors with high robustness, the numerical analysis is a powerful tool. We are developing the quench analysis model of the copper–plated multifilament coated conductors. This model consists of thermal and electric circuit analysis. To simplify the analysis, we model the conductor as a two dimensional object neglecting its thickness. For the thermal analysis, heat capacity and thermal conductivity are averaged in the direction of the thickness of the conductor. We also develop the model of the electric circuit analysis for the copper–plated multifilament coated conductors considering non-linear resistivity of superconductors. Since heat conduction is significantly slow compared to the time evolution of current, the temperature and the current can be calculated separately although they are dependent to each other.
We apply a thermal disturbance to a multifilament conductor and, then, examine the time–dependent current and temperature profiles. Also, we analyze a multifilament conductor having a local low critical current region while the current is ramped up.
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