Heat Propagation Improvement in YBCO-Coated Conductors for Superconducting Fault Current Limiters

D. M. Djokic[1], L. Antognazza[1], M. Abplanalp[2], M. Decroux[1]

[1]DPMC, University of Geneva, Switzerland
[2]ABB Corporate Research Centre, Dättwil, Switzerland

Abstract

YBCO-Coated Conductors (YBCO-CCs) used for applications in Resistive Superconducting Fault Current Limiters (RSFCLs) are known to have insufficiently high Normal Zone Propagation Velocity (NZPV) during quench events, which may cause irreparable damage to the RSFCL devices. Elementary modeling, however, of YBCO-CC 2D meander designs on Hastelloy substrate has been well recognized to potentially improve the effective NZPV due to both longitudinal and lateral heat propagation. Further improvements can also be expected based on the substantial enhancement of the effective thermal conductivity of YBCO-CCs with no decrease in the effective electrical resistivity. We have studied the advantage of multilayered structures grown on a cheap fused silica substrate with thickness of 90 microns. The multilayer is composed of the following elements: (1) a several microns thick copper layer designated to enhance the thermal conductivity of the structure, (2) a layer to prevent the inter-diffusion with (3) the Hastelloy top layer used to grow MgO+YBCO and avoid the copper contamination. We demonstrate the measurement of the thermal conductivity of the as-grown multilayer structure and its evolution upon being heated up to 700°C for 1h (YBCO growth condition). We have also carried out 3D FEM simulations in COMSOL Multiphysics® on a meander configuration in line with the obtained experimental value of the thermal conductivity. The simulation results show a marked improvement in both NZPV and effective NZPV as compared to the earlier cases of YBCO-CCs.