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Dynamic loss and magnetization loss of HTS coated conductors with magnetic substrate

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Dynamic loss is an essential parameter to consider for the design of high temperature superconducting (HTS) synchronous machine windings. For HTS coated conductors (CC), the existing definition of dynamic loss only considers the HTS layer, the validity of which compound with magnetic substrate is questionable. In response to the above concern, by use of the H-formulation based numerical multilayer modelling method, the influence of magnetic property of substrates on dynamic loss and magnetization loss of HTS CCs has been investigated. It is widely believed that the type-II high-T_c superconductor with magnetic substrate will generate larger dynamic loss compared to that with non-magnetic substrate. However, the result was rather surprising that the dynamic loss of the superconductor with non-magnetic substrate is slightly larger than the one with magnetic substrate when the background AC magnetic field is low. When the external AC magnetic field is high, the superconductor with magnetic substrate generates larger dynamic resistance than the one with non-magnetic substrate. The critical value of the AC magnetic field is dependent on the transport current in the superconductor. We explain this result in detail in this paper. This work is used to obtain insights into the characteristics of the substrate layer in the type-II high-T_c superconductor, including its relationship with the dynamic loss, magnetization loss and hysteresis loss.

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