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# Numerical investigation of thermoelastic coupling behaviors of stacks of high temperature superconductor during a quench

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Due to the normal zone propagation velocity (NZPV) of a high temperature superconductor (HTS) being about 100-1000 times slower than that of a low-temperature superconductor (LTS), the quench detection is a difficult challenge for HTS structures so far. To propose more effective quench detecting methods and criterion, it is necessary to reveal the mechanism and multi-field coupling behavior during a quench for a HTS. In this work, a two-dimensional thermoelastic coupling model is developed to deal with the quench occurrence and normal zone propagation behaviors as well as the transient thermoelastic responses of HTS stacks. The evolutions of temperature, strain and strain-rate are numerically obtained by homogenized and layered finite element models for REBCO composite stacks during a quench triggered by a heater respectively. There shows a good agreement between the predicted NZPVs by the present model and the existing experimental results. The inherent relation between the thermoelastic response and the quench event is determined by the evolution of strain and strain-rate associated with the temperature. At locations far away the heater, the strain and strain-rate curves show observable decreasing behaviors and extreme points before normal zone arrives. And inflection points are also observed on the strain-rate curve which precisely correspond to the critical temperature values, showing the occurrence of a quench. Thus, the strain and strain-rate decreasing behaviors may be used to detect a quench earlier and the corresponding extreme points could be effective mechanical criterion for quench detection in HTS structures.

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