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Numerical modelling and calculation of mechanical properties of HTS magnet wound with multi-thickness armored REBCO tapes

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High-temperature superconducting (HTS) magnets have been widely used in the fields of electricity, transportation, medicine, and scientific experiment. However, HTS magnets generally suffer from the thermal stress and electromagnetic stress during manufacture and operation, deteriorating its mechanical properties as well as restricting its further development. This study is aimed at improving the mechanical properties of HTS magnets by applied multi-thickness armored REBCO tapes. The electrical and mechanical properties of short REBCO samples with multi-thickness armor were measured firstly. Then, we have built a finite element model to calculate the stress of the HTS magnet from various sources, in which the properties of the superconducting material are described by the measured data with an interpolation approach. Based on this model, the highest stress position of the HTS magnet has been revealed, and we have optimized the magnet by utilizing multi-thickness armored REBCO tapes to prevent the possible mechanical failure. The result shows that the design of utilizing multi-thickness armored tapes can improve the mechanical properties of superconducting magnets, and provide a reference for the design of HTS magnets in the future.

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