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Thu-Mo-Po.06-05: Compressive stress-strain analysis of stacked REBCO tapes for HTS magnet applications

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High-temperature superconducting (HTS) magnets, fabricated by winding HTS tapes, are widely utilized in various advanced applications. During operation, these HTS magnets and their wound HTS tapes are subjected to compressive loads caused by external factors such as winding tension, thermal contraction during cooling, and electromagnetic forces, leading to mechanical deformation. Previously, the mechanical properties of HTS tapes have been predicted based on the material properties and composition ratios of their constituent materials. However, this approach is only valid for single HTS tape and fails to accurately represent the mechanical behavior of tapes in wound or stacked configurations due to interfacial effects. Therefore, it is necessary to study the mechanical properties of stacked HTS tapes to account for the actual behavior of HTS magnets during the design stage.
In this study, stacked HTS tapes specimens were fabricated using rare-earth barium copper oxide (REBCO) tapes, and compression tests were conducted under both room and cryogenic temperatures. A displacement-controlled load was applied up to 100 MPa, and to analyze the plastic deformation region, loading-unloading repeated test were performed 3 cycles on the same specimens. To minimize the effect of the cut edges of the specimens, a specially designed cutting method was developed and applied. The reproducibility of the experimental results was verified through replicated tests on identical specimens.
Based on the experimental results, the stress-strain behavior of the specimens was analyzed, and their surface conditions were examined. In particular, a fitting equation was derived to predict the Modulus based on the strain of the specimens. The findings of this study are expected to provide critical data for the structural design and optimization of HTS magnets during the fabrication process.

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