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M2Po3E-01: Thermal and Mechanical Characterization of REBCO HTS Tapes and Stacks for Magnet Design in the Muon Collider Study

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Muon colliders offer a transformative opportunity in high-energy physics, enabling precision measurements and groundbreaking discoveries at the energy frontier. Their compact design and ability to achieve extremely high center-of-mass energies make them a promising alternative to traditional colliders. However, realizing such machines presents several significant technical challenges, particularly in designing the magnets needed to generate the intense fields required to confine and focus muon beams.

The 40 T solenoid proposed for the Muon Collider study relies on advanced high-temperature superconducting (HTS) materials that must withstand extreme thermal and mechanical stresses. As such, a thorough understanding of the thermal and elastic properties of the materials used in the magnet is crucial to develop functional designs that ensure both performance and structural stability under high-field conditions.

Due to the limited available literature on this subject, an extensive experimental campaign has been conducted to characterize a range of REBCO HTS tapes with potential for use in the final design, as well as tin-impregnated stacks made from these tapes. The study focuses on measuring the thermal contraction coefficient, thermal diffusivity, and conductivity, along with the elastic properties of the materials under operational conditions.

The data from this campaign are essential for optimizing magnet design, from material selection to stress management strategies, ensuring the reliable operation of the solenoid. Additionally, these findings could offer valuable insights for other industries and applications utilizing REBCO tapes.

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