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Feasibility Study of MgB2 Cable for Pancake Coil of Energy Storage Device

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Since MgB2 wires have been developed and commercially available, large scale cable assembled with MgB2 strands is required for fabricating Superconducting Magnetic Energy Storage (SMES) devices. To form the MgB2 superconducting material, heat treatment procedure is needed forming intermetallic compounds like Nb3Sn. In general, magnets using those types of materials are constructed in simple processes, where the magnets are wound before heat treatment, namely "Wind and React (W&R)"method, and the heat treatment process is performed before coil fabrication, called "React and Wind (R&W)"method. The W&R process simplified initial development. The R&W process has several important advantages, such as reasonable heat treatment reactor size, simple insulation, compatibility with existing coil winding and SMES manufacturing, and dimensional control of the coil. Therefore, we have chosen to explore the R&W approach. For instance, the difficulty of applying the R&W process is that we should design the cables and magnets in which the strain must satisfy the acceptable level, only 0.24 %after heat treatment. To verify the applicability of the fabrication process, we performed the feasibility study based on the bending strain analysis of cable and double-pancake coil for several tens of kJ class SMES system. Calculation of curvature distributions based on a three-dimensional space curve theorem for both round cable and rectangular cross section cable like Rutherford type are investigated. They strongly depend on cable dimension parameters such as twist pitches, coil radius, and conductor former. The investigated results can allow us to construct the robust energy storage system using MgB2 wires.
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