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Wed-Af-Po3.25-06 [110]: Experimental and numerical study on crack evolution of Nb barriers causing Ic deterioration in multi-filament MgB2 strands during cabling process for large-scale energy storage coils.

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MgB2 strands have been highly developed commercially, providing great interest in superconducting magnetic energy storage (SMES) applications with low cost by using liquid hydrogen (LH2) as a coolant due to the higher critical temperature compared to the boiling temperature of the LH2. Therefore, the MgB2 SMES is promising device, giving us a remarkable synergy effect by combining the stabilization of fluctuated power originated from renewable energy sources and supply of hydrogen gas for developing hydrogen-based society to reduce the carbon foot print. For the applications with large stored energy, the current capacity of MgB2 conductor should be large for the compensation of the power fluctuations. In this sense, we need to fabricate large scale conductors for making SMES coils with large stored energy. Our group has been investigating the feasibility study of SMES using MgB2 indirectly cooled by liquid hydrogen. In our investigation, the deterioration in critical current of Rutherford cables has been observed. Cracks in Nb barriers became apparent by measured images of the cross sections of the deformed strands with high-resolution, X-ray source CT, which are considered to be caused by strand bending and/or dents at the strand cross over points during cabling process. To clarify the mechanism of the damage of the strands, numerical simulation based on non-linear extended FEM is also performed. The calculation showed that some overlap points in the Nb barrier covering the MgB2 powders produced by CTFF method would behave as crack-initiation during loading. The experimental and numerical approach for analyzing deteriorations in superconducting characteristics of MgB2 strands shown in this report will lead to the further development of large-scale, cost effective storage device which has great potential to increase the electric power generated by uncontrollable energy sources.

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