SMALL DOUBLE PANCAKE COILS MADE WITH SECOND GENERATION HTS WIRE TESTED IN HIGH MAGNETIC FIELDS

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Introduction

For the production of Second Generation (2G) HTS, based on a Coated Conductor approach, American Superconductor (AMSC) uses a low cost combination of deformation-textured NiW substrates (RABiTS™) with an epitaxial oxide buffer layer and a solution-based YBCO layer [1-3]. The high field properties at 4.2 K make the 2G conductor interesting for high field NMR, and for this reason small coils are tested on a regular basis at 4.2 K and fields between 10-25 teslas.

Experimental

In the past year the processing width of the 2G HTS conductor was extended to 40 mm, an important step in the scaling of its manufacture. At the end of all deposition steps the 40 mm wide foil was slit into multiple 4 mm wide insert conductors, which were subsequently laminated to copper 155 on both sides for mechanical and electrical stabilization. A second step was the modification of the YBCO chemistry to reduce the difference of the critical current in perpendicular and parallel magnetic fields with regard to conductor plane. This field dependence of the doped YBCO was explored at 20-25 T using a modified ITER barrel that could accommodate tape-like conductors. Second, coil manufacture was developed for the 4.4 mm wide conductor which included improved insulation and epoxy impregnation methods. Several double pancake configurations were tested which used 10 m long conductor pieces per pancake.

Results and Discussion

The doped YBCO conductor was tested in a parallel field orientation. The performance was virtually unchanged compared with the undoped conductor (450 A/cm-width at 25 T). As the parallel field performance can decrease with an increase in the perpendicular field performance, this was an important confirmation of the high field, 4.2 K performance, and of the capability of the slitting and lamination steps at the end of the 2G HTS manufacture. The ITER barrel configuration was very useful even at these high fields, and with a tape-like geometry.

The double pancakes were tested at fields of 0-19 T, the first time this configuration was explored at 4 K and high fields. The assembly stably carried 300 A in fields of up to 19 T. The assembly quenched at 340 A, independent of field, likely caused by the inner joint where current transfers from one coil to the other. Repeated quenching did not damage the coils. Coils were measured again in zero field at 77 K, and the self field performance was exactly the same as before the 4 K measurements.

Conclusions

Second Generation HTS conductors are made using an important scaling step, processing at a 40 mm width and slitting to final conductor with at the very end. The stabilization, applied through a lamination process, has been very effective for 4.2 K, high B performance. The conductor geometry is sturdy enough to allow coil construction suitable for use at fields up to 19 T, without any further reinforcement. The double pancake coils could be safely quenched without sustaining damage. Dopants used to increase the field performance in the c-axis direction could be included without seriously affecting the parallel performance, as was demonstrated at fields between 20 T and 25 T.

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References

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